Final Report:

Conceptual Design of Proposed FKIP Facility at Unsyiah University

Prepared for the United States Agency for International Development (USAID)

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Acronyms and Abbreviations

Acronyms	Abbreviations
AC	Air Conditioning
ADA	Americans with Disabilities Act
BCR	Building Coverage Ration
ECM	Energy Conservation Measure
EDC	Education Development Center
ELL	English Language Learner
ESL	English as a Second Language
ETM	Evaluation, Testing and Measurement
DBE 2	Decentralized Basic Education, Program Component 2
FKIP	Teacher Training Faculty
GFCI	Ground Fault Circuit Interrupters
HVAC	Heating, Ventilation and Air Conditioning
IAIN	Institut Agama Islam Negeri Ar-Raniri
ICB	International Competitive Bid
LCB	Local Competitive Bid
PC	Personal Computer
PCS	Pieces (unit of measurement)
PGSD	UNSYIAH's Lempeneuret campus's Primary School Teacher Training Program
UNSYIAH	Syiah Kuala University's
USAID	United States Agency for International Development
VOC	Volatile Organic Compounds
3G	Third Generation

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I. Overview

The following report is based on field-based interviews and participatory design activities with the faculty, students and administrators of Syiah Kuala University's (UNSYIAH) Teacher Training Faculty (FKIP) from February 24-March 9, 2006. The objective of this nearly two weeks of work was to assist FKIP instructors, administrators, students, as well as those of neighboring university FKIP's primary and secondary schools, in the conceptual design of the United States Agency for International Development's (USAID) proposed construction of a new FKIP facility (henceforward referred to as the "proposed facility," "new building," or the "new facility") to be undertaken in Fall 2006.

The goal of this new facility is threefold:

- Provide the UNSYIAH FKIP with a facility that can help instructors and students teach and learn in the most effective manner possible.
- Be designed in such a way that it facilitates instructors' shifts to more learner-centered or active learning methodologies. (These will be discussed in Section IV.)
- Incorporate those design elements that educational research has identified as "high performance" physical features necessary to improved learning. These high performance features are mentioned throughout the report and include such elements as increased amounts of natural light, modern functioning technology, reduction in sound reverberation for improved acoustics, etc.

Educational research identifies a number of benefits, listed below, that schools, not just students and instructors, can realize by incorporating high-performance features into their facilities. Some of these include:

- better student performance;
- enhanced morale;
- increased average daily attendance;
- increased teacher satisfaction and retention;
- reduced operating costs;
- positive influence on the environment; and
- ability to use the facility as a teaching tool.

The activities and interviews were intended to produce a concept design rather than a finished architectural proposal with conceptual space organization and layouts. This concept design (or pre-design) focuses on the intended actions, behaviors, and feelings of the users within the new facility. The intent is to describe what users will do within this new space and how the space can support—indeed make possible—the activities that would otherwise not be possible in a different or more conventional type of structure.

As mentioned, the proposed FKIP facility is intended to help FKIP instructors apply more learner-centered (or "active learning") methodologies so that their students, future graduates of the FKIP and future junior and secondary schools teachers in Aceh province, will learn how to apply the same instructional innovations with their students. In concert with the construction of the facility, instructors at the FKIP will receive ongoing professional development through the USAID-funded and Education Development Center (EDC)-administered Decentralizing Basic Education Program, Component 2 (DBE 2). FKIP and UNSYIAH administrators will receive training and support in facilities management through the DBE 2 component of this program.

The focus of the two weeks of work at UNSYIAH was to help FKIP instructors envision how the design and function of the new facility could complement and make possible innovative instructional methodologies. We focused on this aspect rather than the details of new buildings and equipment because it is crucial to have the building support the pedagogical aims of the new school, rather than force the pedagogy to fit the building.

The information presented here was gathered from a number of teacher, student and administrator (UNSYIAH and the FKIP) interviews and focus groups; document review; observations of instruction and space; and consultation with two engineers from UNSYIAH's Faculty of Engineering.

The scope of work focused on the provision of a conceptual design and a preliminary budget estimate for the proposed facility. However, in order to give both USAID planners and future physical designers a “head start” on a project with a tight timeline, this report also provides, where possible, additional physical and infrastructural information. This information is beyond the original scope of work and is intended as background, contextual information. This document does not substitute for a more comprehensive engineering report. Specific site and building specifications, as well as more exact costs, will be provided by the architects and engineers in the next phase of this project (the “design-build” phase).

Recognizing that different readers will have different interests, the report is organized into ten separate sections. These sections are noted in the Table of Contents so that readers may go directly to their area of interest.

Specific recommendations are presented throughout the report as they pertain to the topic discussed. More general recommendations are presented at the conclusion of the report. The budget is attached as Appendix One.

II. General Information about the UNSYIAH FKIP

The FKIP (pre-service teacher faculty at UNSYIAH) is organized into 14 study program within seven departments (science, math, primary, home economics, English, counseling, and educational technology) for students intending to receive certification in junior secondary and senior secondary teaching (primary school is a focus unto itself). Students and instructors at the junior and senior secondary levels take classes at the FKIP facility at the main UNSYIAH campus, where the new facility will be built.[1] Though the facility will be open to all, they will be the primary users. The primary school pre-service teachers are spread across two satellite campuses at various distances from the main FKIP campus (Go Heng and Lampeneuret), the conditions of which are substandard.

The present and future UNSYIAH rectors have spoken of their desire to integrate the students from the two primary school campuses into the new facility. They have also spoken of opening the facility to FKIP students from IAIN and Muhammadiyah Universities, as well as to local primary and secondary schools. There are no immediate plans to consolidate the various UNSYIAH campuses, though this may happen at some point.

A. Space Requirements

The present state of the current FKIP facility will be discussed in detail in the next section of this report. Generally, the FKIP's need is one of space. UNSYIAH planners have determined a need for 30 additional classroom spaces for a projected total (within the next 20 years) of 12,000 students. The 30 classrooms are based on a formula of 20 students per class (a total of 600) with four class sessions per day, five days per week, with 150 sessions per day. Based on these calculations and an average classroom size of 9 x 7 meters, the FKIP estimates that it needs 1890 square meters of classroom space.[2]

This need for new space, however, does not take into account the possibility of retrofitting the existing FKIP space (particularly the administrator’s office, science lab, teachers’ room and student room, which will be relocated to the new facility) for classrooms when the new FKIP facility opens. Nor does it take into account the conceptual design team's desire for expandable and flexible space with alternating size classrooms. Additionally, it does not take into account the number of potential new users of the FKIP facility should the goal of collaboration and open sharing of space with IAIN and Muhammadiyah and local primary and secondary schools occur.

B. Intended Users

Presently, the FKIP has approximately 5600 pre-service students and 314 instructors on all of its three campuses, but 3500 students and 264 instructors at the main campus where the new facility will be located and by whom the new facility will be mainly used. Primary users of the facility will be FKIP instructors and FKIP pre-service students, typically ages 18 to 22. It is also possible that the 2100 or so students from the FKIP’s two satellite primary school teacher training facilities will also use the site. Additionally, there is also a stated desire to open the facility to the larger education community (associated primary and secondary schools with whom FKIP faculty will work) and to general community members wishing to take continuing education courses.

Table One provides a breakdown of the number of instructors and students at the FKIP main and satellite campuses.

Table 1: Student and Instructor Breakdown—FKIP Main and Satellite Campuses

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[1] We were unable to obtain an actual physical plan of the existing facility.

[2] All data are provided by UNSYIAH University. The methodology for deriving such numbers is not known.

Campuses	Instructors	Students
FKIP Main Campus	250	3500
Primary School Satellites	64	2100
Total	**314**	**5600**

Thus, the intended user population is highly variable and contingent upon a number of actions that, as of this writing, have not been formulated. There is some question as to how the university conducted its student population projections. At the very least, it is probably safe to say that the combined FKIP teacher training facilities should accommodate approximately 5600 students (this includes all 3500 or so at the main campus and builds in extra room for the 2100 or so students from the two primary school campuses), 314 instructors, and one administrator and his supporting staff.

III. Proposed FKIP Facility: Site Analysis

This section is intended to provide information on the conditions and context for the existing site and intended facility information. As far as we are aware, there is no actual site plan for the proposed space.

A. Parcel Location and Size

The parcel for the future FKIP site is located on approximately 8,445 meters squared adjacent (south) of the existing FKIP facility, within the city of Banda Aceh, and less than five kilometers from the Indian Ocean. The parcel (and hence the new FKIP facility) is directly adjacent to the existing FKIP facility (the present FKIP will be north of the new facility) and classes will occur in both FKIP facilities. This proximity and the fact that the two buildings will share people, equipment and resources should be borne in mind in the physical design phase.

The site currently houses temporary FKIP classrooms which will be removed to make way for the new site. The site is rectangular in shape and appears to suffer from drainage problems. Because Banda Aceh is at or below sea level, the site will need to be graded and raised at least one meter (the existing FKIP was elevated one meter in order to prevent flooding) before construction begins. Similarly, a soil analysis will need to be conducted to determine the impact of soil type on the foundation, etc. These costs—soil analysis and grading/elevation—have been figured into the overall budget (see Appendix 1).

Figure 1: **View of parcel facing north**

Figure 3: **View of parcel facing east**

Figure 2: **View of parcel facing south**

Figure 4: **View of parcel facing west**

B. Facility Size and Layout
UNSYIAH engineers estimate a Building Coverage Ratio[3] (BCR) of at least 40 percent, not including parking and green space.[4] This means that the actual floor space of the proposed facility would comprise only 40 percent of the total lot size. The remaining 60 percent of the site would be dedicated to pedestrian walkways, set backs from the road (between 8-12 meters according to engineers), distances from adjacent buildings (20 meters) rights of way, etc. Based on these estimations, the new facility would comprise 3378 squared meters.

This BCR requires further investigation as we were informed during various interviews that the ratio was "30 percent" and "40 percent." For that reason, it is difficult, if not impossible, to assign a footprint size to the proposed facility. Any physical measurements outlined in this report (particularly in later sections) should be interpreted in light of this variation.

Both engineers and those participating in the conceptual design process ("design group" or "design team") envisioned the facility as one unified three-story structure with a central open courtyard. This is the exact design of the current FKIP facility and makes human movement from one room to another less than efficient. This stated layout desire may be more a result of a lack of familiarity with varied architectural designs and layouts than with an actual preference for one joined space (particularly as there is apparently no university code that demands unitary structures). The design group would benefit from seeing several building layout options and exploring alternatives to the traditional layout of double-loaded corridors stacked atop one another.

This new facility, an anchor in UNSYIAH's master plan, must reflect the scale and proportionality of adjacent buildings and conform to local Acehenese and university building regulations and the architectural character of the campus (though this is often difficult to discern). These include, but are not limited to the following:

- Fitting the physical context by scaling the building and site to neighboring structures and spaces.
- Using traditional roofs (gabled) with some overhang to protect against rain. The roofs should be cladded with tile.
- Using lightweight concrete for construction of walls and edifice. The engineer reports that this lightweight material acts as a cooling system, keeping classrooms and offices cool without the need for air conditioning.

C. Infrastructure Requirements
Infrastructure requirements consist of the following:

- Paving and creating pedestrian access to, from and around the facility (walkways, parking areas, etc.)
- Ground water treatment for use within the building for non-potable purposes (flushing latrines, science lab experiments, etc.)
- Removal and disposal of sewage and surface water (septic tank)
- Water supply from and to the facility

- Power supply system (electricity)
- Telecommunications system (telephone, Internet system, wireless)

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[3] The United States does not use the term "Building Coverage Ratio." In this context BCR refers to the ratio of the building to the entire parcel size. Closest parallels are European designations of *plot ratio* (the ratio between the floor area of a building and the area of the site: it takes into account all the levels of the buildings and helps determine the urban density) and *site coverage ratio* (the ratio between the area occupied by a building and the area of the site. It gives an idea of the land use). However, these definitions should be rechecked by project engineers.
[4] This limitation is set by the university. Engineers state that the BCR is actually 30 percent but that there is room to negotiate the proportion upwards. This obviously warrants further research.

D. Regulations

The design and construction process will need to adhere to local building codes (for example, the loading standard for gravitational load, wind load, earthquake load[5]) and regulations (set-backs and rights of way) as well as university regulations (such as the provision of a number of parking spaces per square meter of the building and providing handicapped access to the facility).

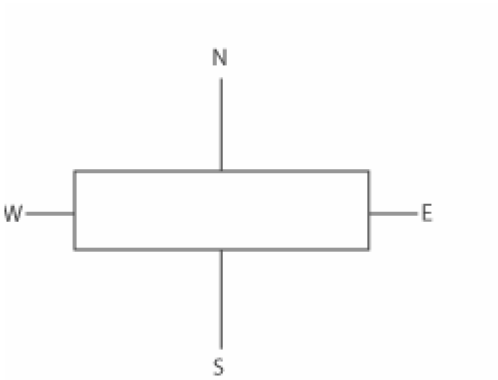

Figure 5: UNSYIAH engineers' recommended orientation of proposed FKIP facility

There are three levels of building and land use regulation that impact construction on the UNSYIAH campus—provincial regulations (Aceh province), city regulations (Banda Aceh) and UNSYIAH campus regulations. There appears to be no university "overlay" system where, for example, the university is exempt from design mandates imposed by a city or province, as commonly occurs in the United States (the University of Texas at Austin governs its own design, building and land use regulations and is exempt from City of Austin regulations on many matters). Predictably, there are areas of conflict among the three regulatory bodies. In that case, typically, the most rigorous of the three standards applies. Entities can apply for the equivalent of a U.S. variance, but the process may be protracted and expensive. However, all regulations should be fully investigated as the physical design moves forth.

E. Earthquake Proofing

Figure 6: Traditional Acehnese design. (This is building is adjacent to proposed FKIP facility site.) Building typology will help confirm the form that is used.

The facility lies in one of the most seismically active regions in the world. Earthquakes occur regularly, as was tragically witnessed in December 2004. The area is designated as Zone Six — the highest risk for an earthquake—and all structures must conform to the highest standards pertaining to seismic regulations. The great risk for faculty and students in the new FKIP facility is that of collapse or structural failure.

Making the building more seismic resistant includes (among other actions): foundation re-enforcement; load stabilization; stabilizing the structure with steel trusses; reinforced concrete; seismic bracing; creating fixed columns to reduce sway; and creating multiple points of exit. The cost of earthquake proofing the facility to bring it up to local and Indonesian Zone Six regulations is included in the construction costs. UNSYIAH engineers estimate that this constitutes 20 percent of the total construction cost.[6]

[5] In the United States, the loading determination is usually governed by the building code. The code applies the intended function to a space and supplies the engineer with the necessary estimated loading for design. When the use of the building changes, the code designation changes, and the allowable floor load also may change — sometimes in a prohibitive way. If a school, or a portion of a school, is to be converted into a library, for example, the entire floor support system may need to be replaced.

[6] Earthquake proofing occurs at all three stages of the construction process: 1.) in the design itself (adding required seismic proofing); 2.) in the materials chosen (steel trusses, lightweight concrete, etc.); and 3.) in the construction process. Workers must be supervised to ensure that they are following numbers 1 and 2.

F. Design Considerations
Though there is no actual regulation dictating the type of design for the building, "custom"[7] dictates that the new facility adopts the typical Acehnese design commonly found on public buildings: three levels of overlapping gabled roofs (see Figure Six), a triangular portico over the entry way (see Figure Seven) and front entrance column supports. The design team has requested modifications in order to make the building more contemporary in design—and allow for more natural light within classrooms, this will be discussed in greater detail in Section Seven. However, because Acehnese structures have a west-east orientation (the longest sides of the building are exposed to the eastern prevailing winds[8]), and because of the use of canopies and windows[9] for cooling purposes, traditional Acehnese structures obscure a good deal of light. Rooms within buildings or houses are often dim.

G. Environmental Considerations and Sustainability
The site is located within a tropical environment that has sunlight and high temperatures and humidity the year round. And because of Aceh's proximity to the Equator, the sun is at a higher angle. One advantage of this is that the amount of natural light available might be "captured" in order to defray energy costs. However, in discussions with engineers, they have cautioned against allowing for too much natural light because of concerns about heat. This "tension" between the need for increased natural light and heating concerns should be investigated further in the physical design phase of this project. Sustainable design techniques and so called "green" features (the use of balconies, sunshades, wider corridors, etc.) would further reduce energy needs of the facility.[10]

H. Cost Summary of Engineering Requirements
Table Two provides a summary of engineering estimates for all the actions outlined in this section as well as parenthetical examples of activities that form part of these actions. These costs are also available in Appendix One.

Table 2: Pre-Construction Infrastructure Requirements and Estimated Costs

Pre-construction Infrastructure Requirements and Estimated Costs *(Includes labor and material)*	
Requirement	**2006 Estimate (US Dollars)**
1. Pre-Construction/Engineering **(Total Cost: $550,000)**	
Preparation and Temporary Work (Obtaining necessary permits, setting up work site, etc.)	$120,000
Grading and Elevation (Soil analysis, removal of debris and standing water, cutting and filling to raise elevation, etc.)	$70,000
Supporting Facility and Infrastructure (Extending road onto the site, pedestrian paths,	$160,000

[7] This is the term used by engineers.
[8] Typically, to maximize the capture of natural light, it is recommended that buildings have an "east—west" orientation, with the idea that rooms are arranged, and people placed within these rooms at certain points of the day, to capture morning light from the east and evening light from the west. Because the sun is so strong in Banda Aceh—and strong storms come from the east—UNSYIAH engineers recommend, for reasons of building temperature—that the building's entrance face west (so morning light is not so strong in the front part of the building and evening light not so strong in the back end of the building)—what they term a "west-east orientation." The existing FKIP also has a west-east orientation.
[9] Windows in Acehnese structures tend to be small to keep out light and heat.
[10] However, the use of such green features raises two issues. First, they may conflict with seismic proofing measures. Next, they add "bulk" to the building which may result in the building exceeding its building coverage ratio by some margin. Designers must investigate whether the use of green building techniques, green features or sustainable design techniques are compatible with seismic proofing specifications and if so, whether the package of green features can be exempted from the Building Coverage Ratio.

Pre-construction Infrastructure Requirements and Estimated Costs *(Includes labor and material)*	
ground water treatment, drainage and water supply system)	
Landscaping and Parking (Creating parking area, paving, etc.)	$200,000
2. Construction **(Total Cost: $3,941,820)**	
Earthquake Proofing (Stabilizing foundation, seismic bracing, etc.)	$2,698, 740
Roof and Trussing (Placement of steel trusses in roof, making roof wind resistant, etc.)	$406, 080
Finishing (Plastering, painting, flooring, tiling, etc.)	846,000
3. Building Infrastructure **(Total Cost: $456,840)**	
Mechanical and Plumbing	$203,040
Electrical	$169, 200
Telecomunication system	$84,600
Total Cost All Phases (1-3)	**$4,948,660**

The total cost for all pre-engineering, construction and building infrastructure costs is $4,948,660. However, there are at least two variables that may impact these costs.

First, the above costs are based on the last facility construction project at UNSYIAH (2004) and have been adjusted by engineers to reflect 2006 costs. However, the cost of building materials is high in Banda Aceh and increases on an almost daily basis, according to engineers, so Section Two of this table may be a low estimate.

Second, the telecommunication system is essentially the cost of a fixed-line telephone system for the building. It does not include Internet cabling or connectivity. Given the ubiquity of cell phones (and the fact that we never once heard a fixed phone ring in the entire time we were there), it is our belief that the fixed phone line can be eliminated and the telecommunication cost category can be assigned to the cost of a VSAT-based wireless system for the present and proposed facility; the creation of a local area network (LAN) and wide area network (WAN); and high quality (CAT 5 or CAT 6 with sufficient wrapping to protect against potential damage or disruption in an earthquake) fiber optic Ethernet cabling, as a complement to the wireless system, as well as to ensure a "future proof" backbone with plenty of room for future growth and convergence with other systems across a local area network.

I. Final Consideration on This Section

Three caveats and one suggestion are important to mention regarding this section. First, the information presented in this section, while double checked with engineers, is the product of translated conversations between Indonesian-speaking engineers and the English-speaking author. Additionally, while we take these costs at face value, we do not know the exact methodology of how they were calculated. The most useful function of these costs is to provide some sort of a benchmark. Therefore, all information presented here must be re-evaluated during the design and building phases of the proposed facility.

Second, the conditions described in this section of the report—the risk of seismic activity, the tropical climate and angle of the sun, the suggested building-to-lot ratio, uniformity of exterior designs, and conventional practices governing light, building orientation, etc. — would seem to substantially narrow architectural and engineering possibilities. However, it is suggested that UNSYIAH engineers be shown various building orientation options, such as a north-south building orientation[11] innovative design and “green building techniques”, in order to create a facility that is structurally sound but that is innovative in design and maximizes environmental factors.

Third, during the next phase of this project, all codes and regulations must be researched to find the exact regulations, the entity setting the regulation (university, city or province) and the possibility and cost of variances.

Finally, designers and engineers in the next phase of this process should look into building techniques that are:

- *cost effective*: particularly energy-analysis tools that optimize energy performance and use of life-cycle costing, for example; and
- *sustainable:* energy-conservation and renewable-energy strategies; high-performance mechanical and lighting systems; environmentally responsive site planning; environmentally preferable materials and products; and water-efficient design.

Part of this cost-effectiveness and sustainability might involve research in potential use of solar panelling to lessen energy costs. Currently, there is not much knowledge about or experience in the use of solar panelling for energy storage in the area.

[11] A north-south orientation is desirable if prevailing winds are from the east. In such an orientation, designers maximize the side facing the wind; use smaller walls on the south side of the building; and use larger windows to take advantage of the prevailing breezes.

IV. Needs Assessment of the Current FKIP Facility

Despite the proposal of a new FKIP facility, the present FKIP facility will continue to exist and it is important to get an idea of that faculty's condition.[12] A number of the challenges facing the FKIP faculty, detailed below, give rise to the facilities focus of the conceptual design principles discussed later in this report:

1. Lack of space resulting in large classrooms of 50-60 students. The result is that space issues impede varied instruction and typically accommodate only one teaching style—lecture mode and whole-group instruction. The lack of space also means that students have nowhere to congregate to take advantage of formal and informal learning opportunities.

2. Lack of equipment within classrooms, such as furniture, sufficient chairs, overheads, computers, projection screens, and blackboards, often prevents teachers from successfully delivering content.

3. Lack of flexible space. Classrooms (*ruangs* as opposed to lecture halls or *aulas*) are all the same size (9 meters x 7 meters) regardless of the number of students. Inflexible space often leads to inflexible instructional styles. It naturally follows that rigidly segmented spaces do not allow flexibility in instruction and learning activities.

5. Poorly maintained facilities. The present FKIP facility is poorly maintained. A tour of the facility evidenced a leaky roof, mold, dirt, debris, garbage and discarded furniture in classrooms, lecture halls and public spaces, such as the central courtyard and corridors; as well as poor air circulation, acoustics and light.

4. A lack of natural light within classrooms. Research has demonstrated that exposure to natural light enhances student learning. In contrast, the FKIP classrooms are dimly lit. This is the result of a number of factors, including those listed below:

- Situating classrooms along a north-south axis (As opposed to east-west to catch morning and evening light. A North-South orientation for fenestration is used in tropical countries to minimize heat by allowing for diffused, versus direct, light.)
- Structural factors such as louvers above windows, which act as ventilation conduits, the overhang of traditional Acehnese roofs and structural supports outside windows—all of which combine to seriously reduce the amount of light entering classrooms.
- Some discoloration and dirt accumulation on tables, chairs and floors, which makes rooms seem somewhat darker than they are.
- Size of fenestration- possibly too small.

6. Underutilized and inadequately arranged space. Space is not organized to achieve maximum benefit in the present FKIP facility. Upon entering the building, for example, one stands in a very large and under-used ante-room or lobby. While some transitional space is certainly necessary to demarcate the exterior from interior, this transitional space is too large because it currently serves no discernible purpose. There are few places to sit, little information to gather, no formalized entry into the facility and no organized activity within this space. The central courtyard, which could be used as a gathering spot, is similarly empty of people and overgrown with flora.

[12] If possible, the physical design group should be provided with a detailed, measured site plan as well as *Report on UNSYIAH FKIP Educational Conditions and Priorities in Aceh Province* (Flores, August 2005) to better understand the shortcomings mentioned here.

The teachers' room presents another example of space that is sub-optimally utilized. The room is primarily filled with oversized, heavy desks, with only one chair per desk. The bulk of the desks makes them difficult to move and there is not a lot of free space available. From a functional point of view, the teachers' room, while large, can only accommodate a handful of people and is therefore not a viable workspace for teachers. Smaller desks or carrels more thoughtfully arranged could accommodate more teachers so that the teachers' room could become a viable work area that might lead to greater collegiality and collaboration among instructors.

All of these challenges, compounded by the impact of the tsunami, make it difficult for FKIP faculty to deliver effective and appropriate instruction and encourage a largely singular, lecture-based, instructional style. Additionally, faculty often has not received adequate and up-to-date training on subject content, curriculum, assessment, classroom organization, and pedagogical innovations, such as active learning. Due to the conditions of the present FKIP facility and a faculty largely unfamiliar with innovative pedagogy, the design process was at times challenging as participants remained very "facility focused" and continued to lapse into familiar paradigms of wanting space that promotes traditional instruction.

V. Active Learning: An Overview

Because the proposed facility is to be designed in such a way that its layout and design elements support active learning methodologies, a description of active learning is in order.

Active learning (also known as "student-centered" or "learner centered" instruction) is a teaching and learning methodology in which activities are organized so that the student, rather than the instructor, is doing most of the cognitive work. In contrast, in "teacher-centered" or "traditional" instruction, the teacher does most of the work (lecturing, for example) while students listen passively or take notes. Traditional instruction typically involves whole group instruction, lecture, short answer questions, or individual seat-based "quiet" work. While lecture is often an effective way to deliver information in a short amount of time, research on learning and cognition show that students retain only five percent of what they hear.

With an instructional methodology grounded in active learning, the instructor acts as a facilitator who creates the context for learning. This is done by teachers setting up the activity as a project, problem or case to be created, solved or analyzed by students. In this context the instructor facilitates student learning, intervening in a highly scaffolded way—by guiding, questioning, and directing students to necessary resources, until students arrive at an answer.

While the learning may be physical in an active learning methodology, with students moving about the room or at a learning site (for example, conducting interviews or interviewing tsunami relief workers at a local NGO office), the adjective "active" refers to students' high degree of cognitive and affective engagement with the task.

There are a number of active learning approaches (project-based, problem-based, case-based and inquiry-based methodologies to name a few) but all active learning methodologies are governed by four commonalities:

- Learning is *collaborative* (students work together in groups, teaching and learning from one another, negotiating differing points of view, and arriving at consensus)
- Learning focuses on the cultivation of *higher order thinking skills* (application, synthesis, analysis and evaluation of information; creativity and problem solving; these higher order skills are often collapsed under the term, critical thinking)
- Activities are *authentic*. Students are given real-world problems to solve (balancing population growth and available land supply in a community—problem-based instruction); a project to create (conducting a pre-design of a new teacher training facility— project-based instruction); a case to analyze (common in law and medical school—case-based instruction) or an overarching question which they must answer through inquiry and research —inquiry-based learning)
- *Assessment of learning is on-going* (or formative) and performance-based (meaning students must show that they know how to apply what has been learned) and criterion-referenced (meaning that students' demonstrate learning by meeting pre-defined criteria aligned with the objectives of the activity)

What would one expect to see in a classroom where active learning is practiced? We begin by what one should *not* see—students seated quietly in rows listening or taking notes and a lecturer at a podium, table or laptop with projector speaking for the whole class period, though this is not to imply that lecturing does not have its place. Nor should one see one-to-one computing—students interacting with laptops and not with each other.

Rather one should see the instructor providing students with a problem or project, offering brief directions on how to get started on their task, and giving students the freedom to figure it out using available resources and one another. One should see students collaborating in groups of varying configurations (pairs, three to four, five to six, etc.), and moving about the room to ask other groups questions, get resources or seek clarification from the instructor. Students may need to share a laptop—one between pairs or one between a four-person team—to accomplish this task.

Thus, classrooms in such a facility must be designed to support easy human circulation, greater instructor interaction with students, and increased student collaboration in the classroom:

- Furniture must be flexible (easy to move and arrange into shapes) and modular to support various types of student group formation.
- Fixed elements, such as a teacher's desk, must be kept to a minimum so as to not encourage a traditional "teacher in front of the classroom" mode.
- There should be easy access to resources, other learning areas (library, outside space, labs, and other classrooms).
- Electrical power outlets must be located throughout the room so that students are not confined to a fixed place to work.
- There should be sufficient lighting for optimal student performance, low ambient noise from outside the classroom, and cross-ventilation to keep temperatures cool.
- White boards and tack boards for collaborative brainstorming, team meetings and presentations.
- Option of spilling into an outdoor space- for a varied environment/ experience.

Presently, except for the design team (those participating in the conceptual design process), we surmise that few administrators, instructors or students at the FKIP understand such methodologies. They will, however, receive in-service professional development in these approaches as well as in integrating technology into their subject areas through EDC's DBE 2 program. Therefore, by the time construction is completed (approximately Fall 2007), they should have a fair grasp of how to create and conduct such methods in their classrooms. In this way, the building will complement and serve as a "laboratory" in which to implement what has been learned.

To view online video examples of active learning methodologies, visit Southwest Educational Development Laboratory's *Active Learning with Technology* series: http://www.sedl.org/pubs/catalog/items/tec50.html. This series of nine downloadable videos (approximately 15-20 minutes in length) provides a variety of examples of active learning methodologies that employ technology and can offer a much more immediate visual description of this methodology.

VI. Participatory Design Process

Figure 7: Traditional Acehnese design over the front entry way.

The best people to design a facility are the ones who will use it most. By involving users in the design process, participants feel ownership, responsibility, accountability and pride. This was certainly the case in the design process that occurred on February 27-March 2, 2006.

The conceptual design (or pre-design) process occurred over the course of a week and was carried out by four four-to-five person teams[13](an Unsyiah FKIP faculty member from the main campus, an FKIP student from the main campus, and a teacher from a local primary or secondary school, and later in the week an FKIP student from FKIP's satellite PGSD—-primary school teacher training—program). Each team had one person with English-language skills so that they could translate instructions and read materials prepared by the design facilitator.

The most important consideration for the proposed FKIP facility was one of function—how would teachers and students use the new facility? How could the design and layout lead to more effective instruction and improved learning? What would be needed in terms of design, layout and equipment to help support instructors' successful adoption of active learning instructional methods?

The participatory design process was iterative, combining small group work, reports and discussions to the larger group, ranking priorities, revisiting assumptions and attaining consensus. The actual design process was preceded by two days of Unsyiah FKIP teacher and student interviews, and focus groups with rectors, deans of the FKIP, teachers and students from Unsyiah, Muhammadiyah, and IAIN FKIPs. All major pieces of information arising from interviews and focus groups are integrated into this report.

A complete design did not emerge after several days of discussion, and that was not the intention. Participants did, however, emerge with a clear direction for the design concept — from the type of instructional activities to be deployed, to the principles the new facility is to embody, to the architectural style to the general building layout, and the monetary and physical constraints of the proposed facility. These are all discussed in the remainder of this report.

A. Parameters for the Design Process

a. Space Requirements

The FKIP Dean defined the faculty's priority areas for the new facility. They will be described in the next section but are listed here, in order:

- Classrooms
- science laboratory
- library

[13] No representatives from the other Unsyiah faculty, from partner universities or from FKIP administration and Unsyiah administration were able to attend the design days (the FKIP Dean did stop by periodically to observe). Though representatives from Lampeuneurut and Go Heng campuses (all part of the primary teacher training faculty) were asked to participate, their attendance was brief, though one PGSD student remained for the last two days of the design process and was very actively involved.

- prayer room
- student gathering space
- teacher/ staff rooms
- administrative and other support areas

Similarly, to avoid departments competing with one another, both the rector and FKIP dean provided a list of priority subject areas. Priority areas were defined as science, math and English. Therefore when the needs of one subject area instructor collided with a "priority" area, the dispute was resolved in favor of the priority area.

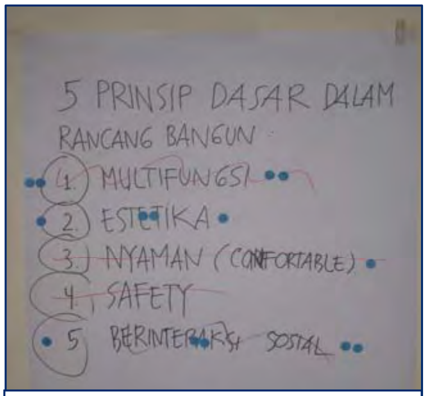

Figure 8: Design team members listed learning principles and selected the five most important through a nominal ranking technique.

b. Protocol for Resolving Conflicts

One challenge in designing a new facility is to gather massive amounts of conflicting information from a number of diverse individuals with their own specialized, and often conflicting needs, interests, and agendas, while maintaining some sense of a unified vision. The design process was intended to achieve this unified vision and was a consensus based process. However, where consensus was not immediately attainable, a nominal ranking technique was utilized to come to a decision (see Figure 8). While all decisions were arrived at through consensus, conflict did exist. Because the design process is a series of push-pull factors pitting individual wants against those of the faculty or institution and where aspirations often collide with reality, parameters were established to help resolve these areas of conflict:

1.) The common good would assume priority over individual department/instructor needs
2.) Budget realities would always trump individual wants
3.) Conflict between the needs of the FKIP and the university would be resolved in favor of the university

These parameters were referred to repeatedly during the week.

c. Building Considerations

Finally, the design was governed by four considerations, ranked here in order of importance:

- *Safety*—of the people within and near the facility, the facility itself, adjacent facilities, and the contents of the facility
- *Function*—whatever was envisioned must be useful and serve the instructional goals outlined in the DBE 2 project
- *Aesthetics*—of the building exterior and interior in order to instill a sense of pride and self-esteem among FKIP students and instructors

d. Design as Professional Development

The design process consisted of a series of sequential and cumulative activities to help the design team move through the conceptual phase to a pre-architectural design phase. As involving teachers and students in the actual conceptual and physical design of their learning spaces is not commonly practiced throughout the world, we viewed this as an excellent professional development opportunity for the present and future instructors who were the design team. We worked to ensure that the design team understood as many of the financial, physical, user-defined, and physical inputs to a facility as possible.

Design activities are described below.

i. Activity 1: Understanding Active Learning
FKIP designers were tasked with envisioning a space that supported active learning methodologies, yet were not familiar with how active learning takes place. It was therefore necessary to provide them with grounding in the methodology. This was accomplished by engaging the design team in a four-hour activity in which they were students and the EDC consultant modeled a teacher's role in a learner-centered classroom.

The activity used a project-based approach. Participants were given a scenario, the creation of an electronic display about the new and proposed FKIP facility, to be assembled as a PowerPoint activity. Participants rearranged furniture (from rows of chairs) into four-person tables so that the space could support their activity.

Design team members were organized in four-person teams in a learning stations concept and participated in a distributed learning activity in which learners rotated from one of three "stations"—a desk with folders containing directions and resources about the proposed activity at that station—to another. Stations were as listed below:

- Station 1: *History of the FKIP*
  Task: interview dean or long serving member of FKIP about the history of the present facility and plans for the new one
- Station 2: *Digital Displays* of present and future FKIP
  Task: Take digital photos of present FKI and the new site
- Station 3: *Physical Survey* of proposed FKIP site
  Task: Create snapshot physical survey of site and place data in MS *Excel*

During the course of the activity, each team was engaged in different activities, but by the end of an hour and a half, all had completed the same tasks.

Teams of four were then provided one laptop per team to create their presentation. Presentations were shared with the group using the facilitator's laptop and an In-Focus projector.

The discussion that followed focused on the activity. How did learning occur? How did this differ from their practices? How did the space and arrangement of furniture support their learning? Where did learning occur? What are the advantages of using technology in the classroom, as opposed to going to a computer lab? How could they use technology in their classrooms?

This activity was critical. Design team members had never used laptops; had never used computers anywhere but in a lab or Internet café; had not really ever participated in a classroom-based activity in which furniture was arranged in such a manner; had never used Excel or PowerPoint; and had never previously engaged in a project-based approach. The conceptual design process could not have occurred without this activity as it was essential to set a context for the teaching methodologies that are intended to be used in the spaces they were to design.

ii. Activity 2: Examining Innovative Spaces
The discussion in Activity One provided a good transition into the second activity in which participants were shown images of 50 innovative classroom and school designs and asked to reflexively list their likes or dislikes about each. Images included classrooms, libraries, hallways, offices, transition spaces, auditoria, and outside areas. We then composed a list of characteristics they liked (lighting, lots of windows, rounded exteriors, etc.) and disliked (modern-looking designs). Many of the images are included in Section Eight of this report to provide a visual sense of the kinds of space that participants found aesthetically appealing and conducive for learning.

We began the conceptual design process from the outside in—from the site, to the structure, to the skin (exterior) of the building, the site plan, the services it offers, and finally the interior and associated materials and equipment.

iii. Activity 3: Site Analysis and Examination of Costs

For participants to understand the physical and monetary considerations and constraints that accompany the design of a new facility, they were provided with an overview and explanation of the engineers' preliminary costs and then conducted a "parcel inspection" of the proposed lot.

Figure 9: Walking the lot perimeter.

Participants asked questions about the budget itself, allocation of spending, activities involved in seismic proofing a building, and so on. We discussed the importance of keeping expectations modest and prioritizing goals in light of the spending ceiling and percentage of the budget designated for construction alone.

Participants then inspected the lot (see Figure Nine). They estimated its size and dimensions; viewed the orientation of the proposed building; were shown the location and size of setbacks; quickly inspected the soil, noting that the soil is sandy, composed of sediments, contains standing water, and is at a lower level than the current FKIP facility. This led to brief discussions about engineering requirements, such as soil analysis, grading, elevation, etc. Participants walked the entire site to get a better "feel" for the lot's dimensions and discussed how many floors the new edifice should contain.

The remaining activities here correspond to a charette process. Briefly, in a charette, participants gather to discuss the qualities the facility should possess, adjacencies of space, and intended uses of the facility. An architect listens to these conversations, takes notes, asks questions, and based on this input, creates a series of conceptual sketches of a proposed facility which are then shared with participants for their feedback and comments. The design sketches are then developed and modified until the group reaches consensus on a final visual design.

We did not have an architect to create designs for team members. Instead, the design team created their own sketches. We were able to recruit the services of two young architecture students who took participants' ideas and each night created a sketch that they shared with participants the next day. Some of these sketches are shared in this report.

iv. Activity 4: Developing Design Principles

The intended use (teaching and learning) as well as the philosophy governing use (an active learning methodology) should drive the planning and design process. The placement of people, furniture and equipment in a classroom must be focused on the intent of a lesson and the learning that is to occur. In an active learning design, learning must be hands on, collaborative and participatory, and the spaces designed must foster all of these characteristics.

Since the proposed FKIP facility will give physical form to the values of its many users, participants were asked to create and prioritize a set of design principles that best represented the values of the new facility, focused on the human element of the proposed space, and subsequently framed all design and use considerations. These principles, the heart of the conceptual design process, are listed in Table Three. They will be elaborated upon in terms of the actual design elements needed for the new school in the next section.

Table 3: Proposed FKIP Facility Design Principles

Proposed FKIP Facility Design Principles

1. The learning environment must be safe, comfortable and clean.
2. The learning environment must support multiple types of learning and activities through the use of sufficient and flexible “multi-functional” space that promotes a variety of instruction.
3. The learning environment must inspire students and instructors to higher “levels” of learning, including facility with 21st century technology tools, application of knowledge, creativity, analysis and problem solving.
4. The learning environment must create a greater sense of community within the school and in the larger educational community. Space should be designed in such a way to be responsive to the ever-expanding educational needs of the community the building serves.
5. The learning environment should be a place of beauty that instills pride in being a student and teacher at the FKIP. It should generate a sense of ownership among students, instructors and colleagues from surrounding schools.

These principles will be discussed in greater detail in the next section of the report.

v. Activity 5: Designing the Exterior

After the groundwork of these discussions and activities, the design team assembled into smaller teams to begin work on initial design concepts for the school. They began first with the exterior, designing a façade of one side of the exterior and a layout of the building. This exercise enabled the design team to begin imagining the building, and also served as an orientation to sketching since the drawings were rather simple.

The goal was for the team to create three or four different schemes and begin to prioritize favorable elements from each plan. After a certain amount of time, these teams reconvened to present their ideas for review and receive feedback from the larger group. The two architecture students created a final sketch based on participants’ initial sketches and their stated preferred design elements. By the end of the activity, they would leave with an agreed-upon building.

Exterior Space

Participants stated that they wanted a three story building, with a modified Acehnese exterior organized around a central courtyard, facing west. Figures Nine and Ten are the architecture students' complied sketches of participant sketches. It is important to remember that professional sketches will be done by trained architects. These sketches, obviously not drawn to scale, are included to illustrate general design ideas of participants.

No image of participants' layout is included here since the final layout issue was left unresolved. Participants are open to other designs besides interior courtyard layout and want to see examples of building layouts besides the one they know.

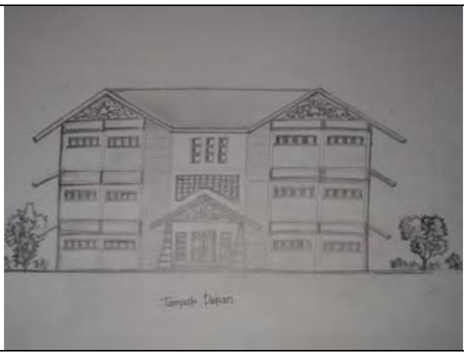

Figure 10: Participant version of front elevation of proposed facility

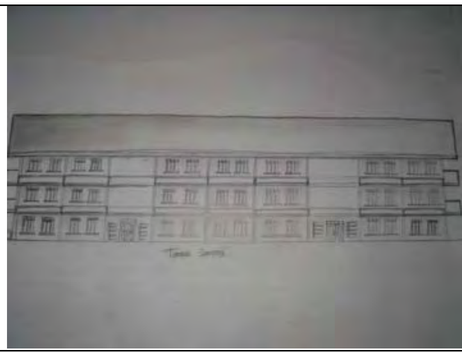

Figure 11: Participant version of side elevation of proposed facility

Between the road and the entry to the new facility is an eight - twelve meter space that forms the boundary and transition area between the public area of the road and the more private space of the new facility. Rather than dedicating this to parking, as other buildings do, participants propose making this into a transitional space with a visual landmark indicating an entrance onto the site (a special place). For this they selected an arched gate (there are many such examples of this around Banda Aceh). To signify the space as a welcoming, social place, the design team advocated the creation of an outdoor café with moveable umbrella-covered tables and chairs where instructors and students can gather, drink tea and coffee (from small stalls on the periphery of the space or from an interior kitchen), study, visit and listen to music or poetry. Tables and chairs would also be placed on the outdoor landing/patio (i.e., space leading from the steps) to provide continuity from the exterior to the interior lobby of the building.

To facilitate circulation, the “arched gate” should contain two open entry ways or portals through which pedestrians can pass—one for entry; the other for exit. These two portals, as it were, would help to minimize congestion and crowding as is often found around one entry way and would allow passers-by to view the café, with the idea that two portals would be more welcoming than one entry.

Since the design team has limited control over the building footprint size, shape and exterior design, as these are truly engineering and architectural decisions that may be governed by regulations, we didn’t spend much time on the exterior/layout components of the design process. As a reference point, Unsyiah engineers—again, separate from the design process—estimate that the proposed facility will be 3340 square meters. Unit costs (cost per square meter) and total costs are presented in Appendix One.

Parking

The university is supposed to provide parking (the number of spaces for which should be determined by the number of square feet of a building *or* a ratio of one space per so many users, though university regulations on this are not clear). It is recommended that car and scooter parking be located at the back of the building or that the university move to an off-site parking system.

Figure 11: Semi-permeable parking ground cover—concrete and gravel. It would be desirable to have less concrete and more gravel.

If such parking arrangements are not possible, parking would need to occur at the front of the building (neutralizing stated preferences for an outdoor café area) and would require, along with landscaping, according to engineer estimates, $200,000. As parking is not separated from landscaping in the engineering estimates, it is presumed that the bulk of this $200,000 is for parking.[14]

Given its cost, the space it consumes, the fact that it essentially nullifies or severely restricts plans for an open gathering area, we strongly suggest that designers investigate alternative ways to reduce or eliminate parking from the parcel. Since this will most likely be a contentious issue and involve possible appeals, requests for variances, documentation, and fees, we suggest that this be one of the first areas tackled by designers.

[14] Cost breakdown and presentation is not consistent through the report. In some cases we were able to obtain detailed costs and in other instances, we were not.

To mitigate water collection and runoff and to lessen the amount of heat associated with impermeable cover (paving), designers should look at some sort of semi-permeable parking cover. (See Figure 11 for an example.)

Landscaping

The grounds of the new facility should complement and enhance the physical structure. Students and teachers need exterior pathways for circulation (As a practical matter if such pathways are not provided, grass and "lawns" will be used as pathways, resulting in large swathes of dirt and mud. To aid in drainage (as rains can be quite heavy and frequent), designers should consider the use of semi- or non-impervious cover (gravel or caliche) to allow water to seep into the soil and avoid the runoff that occurs with impermeable cover. This should aid in drainage around the facility.

Figure 12: Though it can contribute to shade for this second-floor room, this tree's placement so close could aid someone in breaking into the building.

Plants, flowers, shrubs and trees should make the space around the proposed building inviting and attractive so it becomes a place in which people will want to gather and linger. The presence of plants, trees and flowers can also attract birds and butterflies which add to the atmosphere. By creating a garden and green space around the building, the exterior can become an inviting place to hold classes, gather informally, sit and do homework—in short to have more of a typical university campus experience. Plant cover and soft landscaping also reduce heat gain for the site.

As a practical matter, trees can act as cooling devices. They provide shade and when placed by first-floor windows can lessen heat by filtering direct light. However, trees should be placed in such a way that they do not contribute to security problems (i.e., close enough to buildings or windows that someone can use them to climb in through a window). As security needs increase with the suggested investment of technology, designers might wish to place "hostile vegetation" (vegetation with thorns or that causes irritations when touched) around first-floor windows as a supplementary security measure. This will be discussed in more detail in Section Ten.

Two suggestions are made here regarding landscaping:

1. Designers should promote the use of local vegetation for outdoor "garden" areas. If grass is not natural to the area, use low-lying shrubs or some other vegetation that can act as a grass-like cover. Or simply create a natural garden of local vegetation. Xeriscaping is a landscaping technique that uses native, drought-tolerant plants, shrubs, and ground cover to reduce water consumption and care.
2. It takes money and personnel to maintain grounds, but Unsyiah has neither for landscaping. There are one of four ways to address this:

Figure 13: Design team members plan exterior spaces.

a.) As part of DBE 2, part of Unsyiah's professional development can include helping administrators develop a plan and find money for landscaping maintenance as part of overall facilities management.
b.) USAID, could consider setting aside a certain portion of the cost of construction to cover landscaping and grounds maintenance. This money could be used as seed funding to tide over the FKIP until administrators develop expertise in facilities management and revenue to develop home-grown landscaping capacity.

c.) FKIP science instructors could integrate the garden and grounds into biology instruction. Have students, as part of their formation and grade, be required to do grounds and garden maintenance.
d.) The FKIP could use a portion of the revenue generated from food and coffee stalls in the outdoor café area to cover grounds keeping costs. (Presumably, the FKIP would charge food vendors some amount of rent to use the café space.)

Internal Courtyard

In addition to exterior gathering spaces, such as a garden and café, participants advocated the creation of an open-air interior garden for teachers and students to sit, read, visit, or drink coffee or tea.

Figure 14: Creating an Interior Plan

The present FKIP currently has such a courtyard; however, it is rarely inhabited, in part because the courtyard is divided into four separate quadrants. One (or possibly two) of the quadrants contains a dry fountain with no nearby seats. The remaining quadrants, though at one point covered with grass, are now dirt because of the lack of grounds keeping. Because the quadrants are effectively off limits, the only public space—in this public space—is the brick-paved cross path.

The courtyard should be rounded in shape, accessible from the four cardinal directions via stairs to the lower grade level from the ground floor plinth[15] level and should be one unified space with umbrella-covered tables and chairs where students and teachers can gather and take a break. It should contain vegetation for purposes of shade and aesthetics. Water, too, would be nice, but only if is flowing, as in a fountain, because stagnant water attracts mosquitoes and other water borne infections. In addition, cloth awnings or canopies could serve as an overhang from the second floor to provide cooling and shade.

The initial cost of landscaping is consolidated with parking costs. Together landscaping and parking are estimated to be $200,000. (Most of this presumably will be dedicated to creating a parking lot.) This cost includes basic landscaping—planting grass, planting vegetation and creating pathways. It does not include any of the improvements mentioned here, in part because engineers see the front of the building as dedicated to parking. Again, it will be important to present innovative exterior and landscaping designs, particularly as the FKIP design group is open to design alternatives. If parking were eliminated from the site, the amount saved on parking could be used to cover the expenses of setting up the café area.

[15] A square or rectangular base for column or statue; the lower moulding of a podium or skirting.

vi. Activities Five and Six: Designing Interior Space - Creating Adjacency Maps and Creating an Interior Floor Plan

Following the sketch of the interior courtyard, the design team turned its attention to the interior of the facility. The actual design piece was preceded by conversations about how the design principles could be integrated into interior spaces and what would be needed to do this (lighting, moveable and modular furniture, etc.). Participants ranked their priority areas for new spaces:

- Classrooms
- Multipurpose science lab
- Library
- Student Gathering Space
- Prayer Room
- Teacher Room
- Exterior Gathering Spaces

Figure 15: Using *Post-It* notes to create adjacency maps

All of these are discussed in greater detail in Section Eight.

The team began by creating "adjacency maps" or space relationship diagrams—large bubble diagrams that illustrate where spaces are in relationship to one another and how these spaces are connected.

To better understand the concept underlying adjacency maps, one can consider the metaphor of a city street. Businesses are located near one another for numerous purposes - economics, car dealerships tend to agglomerate to take advantage of the person who comes car shopping; a café may be located next door to a restaurant as a complement to people looking for dinner then dessert, etc.). The idea was to apply the same metaphor to the process of interior space design.

Creating an adjacency map does not involve any sort of detailed technical drawing but rather large broad bubbles or circles that show adjacencies of space. The goal is to devise an agreed-upon priorities and a concept drawing that identifies the location of all main areas of the new facility in relationship to one another and based on user preferences and habits.

Unfortunately, that did not really happen. The activity may have been too abstract for participants, who appeared uncomfortable with being so "messy" in their drawings and who immediately leapfrogged to creating detailed diagrams of the interior space that all more or less replicated the same layout (i.e., a design based on the present FKIP facility). In spite of assistance from a Faculty of Engineering architect, the adjacency map activity proved too abstract for the designers and we blended this activity with a discussion based approach.

Figure 15: Charette member explaining her team's layout and exterior design

The activity was useful in that participants gained hands-on experience creating floor plans, and in presentations of their interior spaces, they began to define useful relationships of space. They also began to see how they would benefit from more examples of interior layouts that differ from what they know.

Participants agreed on a number of interior items or adjacencies that should aid the physical design team:

- Street-level spaces should include common areas similar to what might be found in a town plaza
- Public, community spaces (e.g., library and "exhibition" rooms) should be located on the ground floor for easy access to the extended community
- Spaces with the most human traffic (e.g., library and student room) should be located on the ground floor for easy access and also so that people can easily exit the building in case of emergencies
- An outdoor café area that should be taken advantage of for activities open to the community at large. Community members are more likely to stop by when the activity is easily accessible (outside). They will most likely be too intimidated to walk inside the building to attend a performance. Outdoor areas can also be used as spill outs for larger gatherings.

Figure 16: Explaining the team's adjacency map

- Toilets should be stacked and located in the corners of the buildings for plumbing purposes
- Teachers' room should be located away from activity centers so teachers can work quietly
- The multipurpose science lab should be located on the third floor. It was felt that the lab should be "out of the way" in case there was ever an accident.
- The majority of classrooms should be located on the second and third floors
- The prayer room should be located on the second floor so it is accessible from all floors
- The building will need ramps so that laptop carts and TVs can be wheeled up and down floors (because of maintenance and earthquake issues there will be no elevator) and for handicapped access to the facility

vii. Activity 6: Prioritizing Interior Spaces: Elements and Furniture

At this point we discontinued abandoned drawing and returned to a more successful strategy of brainstorming ideas on chart paper, organizing and displaying ideas, publicly displaying them and then ranking preferences from one - five. Section Eight—*Design Features of the Learning Environment*—discusses participants' findings.

viii. Activity 7: Formulating a Facility Steering Committee

While the new FKIP facility will solve the issues of space and equipment needs, it will spawn a host of other recurrent issues that will be addressed in part through the DBE 2 project, but which need to begin being discussed at the FKIP level right now. Recognizing the many complex issues that a new facility, particularly one with technology (particularly mobile technologies), the design team decided to organize itself to begin to deal with the following issues:

- Facility maintenance (interior and exterior)

- Facility management (access, programming classes, scheduling activities, etc.)
- Security
- Technology support
- Assigning staff to be responsible for certain spaces

The steering committee will be comprised of the most dedicated members of the design group, and are as follows:

Lecturers:

- Dra. Asiah, MD, MP
- Evendi
- Siti Khasinah
- Ngadimin
- Sardinah
- Anizar Ahmad
- Hasbi Yusuf (teacher—secondary school)
- Yuhasriati
- M. Husin Affan
- Mahmud HR
- Nurhasanah
- Yusmiwati
- Dian Fazrina
- Zarlaida Fitri
- Potuit Ernawati

Students:

- Surya Darma
- Mutia Fiani
- Feri Sarnita
- Isnar (architecture student)
- Astrid Annisa (architecture student)
- Khatmi
- Zulfatimi

No doubt these numbers will diminish over time but the excitement and energy is evident. USAID should work with these individuals as it moves forward in the design-build process.

The steering committee has created job descriptions for steering committee officers, elected officers, will begin communicating by email, and has scheduled their first meeting on Wednesday, March 8, with Pak Yusuf, the Dean of the FKIP, to discuss the above issues and how to address them. Officers, shown in Figure 17, are:

- President: Dr. M. Nasir Suryah Mara (FKIP instructor)
- Vice President: Erida Fithri (from SMU 9 Senior High School)
- Secretary: Dra. Sulastri (FKIP instructor)
- Treasurer: Dra. Sufiat (FKIP instructor)

Figure 17: Three of four steering committee officers (L-R): Ibu Suryah (T), Bapak Nasir (President) and Ibu Sulastri (Sec).

Some suggestions include:

- charging user fees for non-education community members to use facilities. The revenue generated would be set aside in an account (to be monitored by someone not at the university) for maintenance, etc.;
- charging rent to vendors (coffee, tea, snacks) to generate revenue for maintenance, tech support, etc.;
- creating a work study program to have students provide much of the needed support possible (technology and maintenance, for example) in exchange for tuition elimination or reduction; and
- soliciting assistance from local businesses and NGOs.

The steering committee will meet regularly with, and report to, both the present and incoming rectors.

ix. Design Process: Final Thoughts

The above design principles are an important clue to the mindset of design participants. First, the principles are very focused on the physical building because the participants were themselves so facility focused—the result of the degraded conditions in which they teach. Second, participants found it quite challenging to think differently—about instruction or even the purpose of the new facility—because their experiences are so limited. Third, the design process represented in some ways the post traumatic stress so pervasive in Aceh after the tsunami. Their very first design principle—their own physical safety— is in many ways poignant and reveals their fear about the environment in which they live and work.

The consensual and participatory nature and the various activities of the design process, taken together, ensured that:

- all voices were heard;
- conflicts could be aired, discussed and consensus achieved;
- the strengths and weaknesses of each team design were carefully evaluated;
- design participants chose a scheme that best suited the needs of multiple users (FKIP instructors, students and field-based teachers);
- the design team achieved consensus on all design inputs (from the exterior to types of furniture);
- participants could discuss important “taste-related” issues that though seemingly trivial, are important to users, and can make such a process particularly sticky (for example, colors, materials, etc.); and
- students and instructors participated in a collaborative, authentic, interdisciplinary, project-based learning experience—an active learning approach.

The time spent on the participatory design process was brief but intense five days, about 40 hours in total. After an initial attrition of ten people, the same 20 individuals returned day after day, in spite of being on vacation, in spite of the heat and discomfort of the work area, and despite the fact that the instructors needed to be registering students for the next semester. The energy and excitement of the team was impressive, as was their level of work, especially considering the fact that they had absolutely no experience in this area. The architecture students were wonderful resources and their commitment to this process and desire to assist in it is illustrative of how energized students can be about academics when the learning is real, meaningful and relevant.

There is a good deal of momentum and energy among this group at the present time. They feel a sense of ownership, pride and responsibility in this new facility. They are justifiably proud of themselves.

B. Key Considerations

A number of design elements for the façade, layout and adjacencies of the building are mentioned in this section, but must be considered in light of local design codes and regulations:

- Participants have expressed interest in a "contemporary" Acehnese design for the new facility. It will be necessary to check local building design codes to see if this is possible.
- Participants would like a central courtyard as is typical of most university buildings. Their larger concern, though, is the need for external gathering space and they would therefore be open to other types of layouts. Participants would benefit from seeing a number of visual building layout designs. Designers need to check the regulations governing building layouts.
- Participants would like to move parking offsite or to the back of the proposed facility to allow for the creation of an outdoor cafe. Whether and how they can do so is unclear. Once again, designers will need to find out the regulations governing parking, the location of eating areas (and whether an outdoor café can substitute for a kitchen. The new facility does not include a kitchen area. The existing facility, immediately adjacent to the proposed facility, has a kitchen).
- Though we have outlined some adjacencies (relationships of space), these are probably not as detailed as an architect would normally prefer. It is important therefore to show the participatory design team examples of visual adjacencies so they can better decide on space relationships.

VII. Design Principles and Implications for the New Facility

This section fleshes out in greater detail the five Design Principles mentioned in Section Six and discusses how they contribute to the physical design of the proposed FKIP facility.

A. Principle One: *The learning environment must be safe, comfortable and clean.*

The new facility must be a healthy and productive space. There should be high levels of acoustic, climatic and visual comfort, with adequate amounts of natural daylight, superior indoor air quality, and a safe and secure environment. These values are discussed below.

a. Safety

- The building must be elevated enough so it is not at risk for flooding.
- The building must have multiple single doors for easy exit (in the case of earthquakes). These are preferable to fewer double doors.
- Heavy roof materials must be securely attached to roof structure so there is no damage in case of earthquakes.
- Any exterior canopies or future covered walkways must be engineered to withstand high winds and seismic activity.
- All free-standing large objects should be secured where possible (cupboards, wireless carts in storage, planters, food stalls etc.) to withstand earthquakes. Wherever possible built-in furniture would be preferable.
- Because of the high likelihood of seismic activities, emergency kits (containing water, sanitation supplies, non-perishable food items, and basic First Aid equipment) should be placed at various public access points throughout the new facility.
- Stairs should have handrails and be sturdily crafted to provide support during and withstand the impact of an earthquake.
- Window and fenestration design should also take into consideration the high risk of seismic activity that is a feature of the area.
- Non-structural building contents that pose safety hazards — hazardous lab materials that could be released, or suspended ceilings, light fixtures, equipment that could be thrown to the floor—should be identified and securely stored.
- Electrical outlets in all parts of the facility must be protected with ground fault circuit interrupters (GFCI). This is necessary for safety reasons as well as for protection of electrical equipment and laptop computers.
- Above all, the new facility must be structurally safe so that in the likely event of an earthquake, there is no risk of collapse or structural failure.

Because of the high risk of earthquake and tsunami, and the increased risk of death and injury that occur where there are greater numbers of individuals in an impacted structure, UNSYIAH (or at the very least the FKIP) should use part of this funding to install (and train personnel in the use of) an emergency communications systems.

b. Comfort

i. Climate

Present FKIP interior spaces are hot and even in rooms with air conditioning, there is little cooling (in many cases the air conditioning doesn't work). Switching air conditioning on and off in humid climates creates build ups of condensation which can lead to mold. This is the challenge of designing a school building in a tropical country.

For teachers and students to do their best work, the temperature must be "just right"—not too warm (as happens without air conditioning) and not too cold (in spaces with air conditioning).

And as technology makes its way into classrooms in the form of laptops, a great deal more heat will be generated.

As much as possible architects and engineers should capitalize on the existing climatic features of the site and by designing an efficient structure and systems to increase ventilation and cooling within rooms. This includes the following:

- Designing the building with an east-west orientation with the least possible heat load.
- Creating rooms with sufficient height (high ceilings) to allow for maximum circulation of air (classrooms have a typical length-width-height measurement of 9 x 7 x 12 meters[16]).

Figure 18: Louvers are traditionally used for ventilation purposes. This newly constructed school built by Islamic Relief uses a double system of louvers which was not commonly seen.

- Designing the fenestration (layout of windows) in the direction of the prevailing winds (and using lightweight materials to keep out hot air).
- A central courtyard to help generate air circulation along the peripheral built spaces.
- Planting a green buffer at the building periphery to filter sandy winds and provide shade.
- Using double walled(top-bottom) glazed sash windows to maximize insulation. Sash windows work efficiently to increase ventilation in interior spaces by providing an outlet for the hot air to escape on the ventilator level. The glazing would help to reduce solar glare.
- Installing easy use shutters on the eastern windows to prevent from severe storms and high winds (see Figure 19). This might allay engineers' concerns about having large glass windows facing an easterly direction while still allowing for abundant natural light.
- Providing interior and exterior windows in classroom spaces to allow for cross ventilation.
- Scheduling the most populous classes in certain parts of the building to take advantage of the comfortable day temperatures in pockets of the facility.
- Planting shade-bearing trees near windows and providing green cover around the building to reduce heat radiation from hard paved landscapes.
- Installing low-cost ceiling fans to aid with air circulation.
- Using multiple entries to classrooms and other study areas (two versus one door) so that there are more opportunities for cross ventilation.
- Encouraging teachers to hold classes in shaded outdoor learning areas. (Students, no matter their age, love this.)

For spaces with fixed computer installations (the library, teachers' room, and science lab), air conditioning is a necessity to keep equipment at a constant temperature. Other spaces, particularly classrooms in which laptops reside only temporarily, do not require air conditioning if natural cooling devices can be successfully deployed.

[16] We were also told that classrooms have a typical length of eight—versus seven—meters.

Presently most Acehnese buildings use louvers (or a jalousie) for ventilation purposes. Figure 18 illustrates a “double row” of louvers, which was not commonly seen. Louvers are designed to aid with ventilation, though in the present FKIP site, they do not appear to help much in this regard. While useful for ventilation, the louvers tend to dim the room by obscuring and obstructing natural light. This conflict between light and ventilation should be examined in the design phase of the project.

ii. Light

Figure 19: Large shutters can be used to protect windows against storms.

Educational research has demonstrated that students perform better in well-designed classrooms illuminated by daylight and that people suffering from depression (as many tsunami survivors undoubtedly do) demonstrate positive effects of enhanced mood through exposure to natural light. Windows and skylights that bring natural light into a school, but prevent distracting glares and shadows, can create a more comfortable and pleasing environment for students and teachers.

As much as possible, designers should use “daylighting” techniques with the use of larger, full-side windows (Acehenese windows are small), and carefully consider the placement of windows to reflect daylight deeper into the classrooms. One way to take advantage of natural light too, is to build window seats into the structure of the building alongside windows so students can sit and work in pairs, while taking advantage of natural light and air circulation (see Figure 19). Designing recessed windows also helps to reduce the glare in the interior space by providing inbuilt shading, and maintaining the diffused light levels in the space.

Designers might also consider the use of acrylic skylights in the roof. This can provide greater light to third floor classrooms. If skylights can be opened, it can also help to release some of the hot air within the building.

In the physical design phase, it is important to consider strategies for maximizing ventilation and minimizing glare while also allowing for the greatest amount of natural light into the room. Providing staggered classroom clusters can also result in increased cross ventilation and lighting since there is the opportunity to provide window openings in opposite facades.

iii. Noise

Students can't learn effectively if they can't hear what their teachers or fellow students are saying. Research in the United States indicates that high levels of background noise, much of it from heating and cooling systems, adversely affects learning environments.

Acoustics

Through careful selection of construction materials, classrooms must be designed to create low reverberation (the time it takes for sound to fade or decay in a space) spaces through the careful selection of low reverberation materials. This will be a particular challenge in large lecture rooms. Proper acoustic insulation can help to reduce the reverberation in interior spaces. Providing appropriate finish to the floors, walls and furniture can help reduce the ambient noise significantly. Cheap material like cork tack boards help to absorb the extra ambient noise. Balconies, in addition to providing small, semi-private spaces, can act as noise barriers. (The use of balconies must be considered in light of seismic proofing regulations and the Building Coverage Ratio.)

Ambient Noise

Ambient noise also presents challenges to students and instructors in terms of learning. It's hard to concentrate or take a test when you are bombarded by noise coming from adjacent areas. Designers must mitigate ambient or outside noise with sound absorbing and insulating materials.

It's also important to look at sound transmission with regard to adjacent spaces. For example, offices that are near large, open spaces not only have to be protected from unwanted sound entering, but also must keep sound — and private conversations — from escaping. And, as instructors noted, teachers may not want their work area located next to the student room.

This brings up two additional design considerations. First, the placement of rooms is critically important—designers must think about the occupants and function of the room and space rooms accordingly (e.g., the library should be away from a commons area or student room). Second, sound transmission across boundaries must be controlled through proper construction of the walls and openings.

iv. Air Quality

Instructors and students must know that the air they breathe is healthy. This issue must be borne in mind during the design-build-and maintenance process.

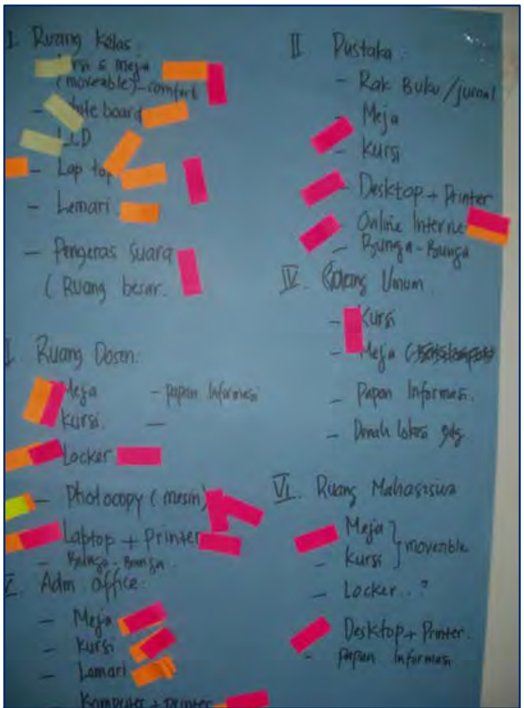

Figure 20: Ranking system for various room elements

Volatile Organic Compounds (VOCs) are emitted from interior materials such as paints, adhesives, sealants, carpeting, flooring, furniture and ceiling panels and can cause health problems. Carpeting, for example, can "off-gas" VOCs when first installed. These gases are potentially dangerous and it is recommended that any facility be "aired out" after painting, laying carpet, etc. Local engineers were unsure of requirements governing VOCs but the US Department of Energy[17] recommends that prior to substantial completion of a school, each building be flushed out with 100 percent outside air for about 15 days, or as long as possible, to remove any remaining odor and VOCs. They also suggest that builders minimize use of floors, walls and ceilings that need finish in order to diminish the emission of VOCs.

Mold. One subset of indoor air quality is mold remediation. The present FKIP appears to have mold problems because of deferred maintenance that allows moisture to seep into buildings and a lack of adequate ventilation. If unchecked, mold can lead to serious health problems for students and instructors. Mold allergies are quite common

[17] See U.S. Department of Energy, *Best Practices Manual for Building High Performance Schools.* Available at http://www.doe.gov. (Search term: title)

and often quite severe—headaches, fatigue and flu-like symptoms are typical indications. Mold is also unhealthy to breathe. Oftentimes, individuals with mold allergies are unable to stay in the area where mold is present.

To prevent mold, the new facility site should be elevated (an elevation to be determined by an engineering team) to ward against flooding, which also causes mold. The facility designers and builders should employ strategies that minimize the need for maintenance, such as anti-mold primer on walls and exteriors, waterproofing bathrooms, using durable and vandal-resistant materials, and so forth.

But mold is best controlled by maintenance. Water leaks should be fixed and cleaned up. Condensation should be wiped away and proper temperature and humidity must always be maintained. Regularly scheduled cleaning and disinfecting can help control the spread of mold. Finally, mold can be mitigated by performing regular inspections and maintenance of HVAC systems.

Mold can destroy a new facility. Architects must take into account that maintenance is poor and it is questionable that it will improve. In many rooms in the present facility, there is a lack of proper temperature and humidity, leaks are not fixed, condensation is not wiped away and regular inspections do not exist. This is a perfect breeding ground for mold.

In addition to these concerns, it is important to investigate local regulations governing indoor air quality.

v. Ergonomic Furniture and Fittings
Students spend a lot of time sitting, and improper posture can cause back pain, eyestrain, and hand and wrist problems such as carpal tunnel syndrome and repetitive motion injuries.

To reduce student health risks, chairs and desks should be available in different sizes to fit different-size students and computer equipment and seating should be adjustable so that students can sit comfortably. Chairs for computer workstations should have adjustable heights and back supports, armrests that pivot and be height- and width-adjustable. Adjustable keyboard trays and mouse platforms also will allow a student to use a computer while maintaining the proper posture. During the second phase of this project (the design-build phase) the architect or engineer should make sure that instructors and students understand these ergonomic conditions.

Railings, hardware and toilet fixtures should follow standards and code specifications.

vi. Comfortable Furniture
Furniture should be ergonomic but also comfortable. In spaces that encourage people to linger (cafés, library, student room, etc.) the furniture must be sturdy and durable but comfortable. This includes having sofas in the library, students' and teachers' rooms so users feel free to read, take a nap, visit with colleagues. Sofas should be comfortable but made of a material that is not too hot and should be easy to clean (no one wants to sink into something that is filthy). Café tables should be sturdy enough, with a surface that is easily cleaned, and with enough table top space to encourage students to sit and study or do homework.

Part of an optimal university experience is spending time on campus. Students and teachers will spend more time if they have comfortable spaces, and furniture, in which and on which to work.

vii. Aesthetics
A large component of comfort is enjoying one's surroundings, thus interiors are important. Consider painting walls with soft soothing colors that reflect light and are easily cleaned and maintained. Consideration of paint types, colors and textures goes beyond mere aesthetic

considerations, though these are important in a new facility. Instructors and students are still suffering the post-traumatic stress associated with the tsunami and it is well documented that color and texture can affect mood, which in turn impacts learning. Students and teachers need exposure to light—and dark colors can absorb needed light. However, a preference for surfaces painted in light colors must be balanced against a lack of maintenance (and dark colors do hide dirt). Whether light or dark, because of maintenance issues at the FKIP, painted surfaces must be easy to clean and withstand possible chemical cleaners without fading. Finally, the brand of paint chosen should be long lasting so that frequent repainting and touch ups are not needed.

viii. Cleanliness

Cleanliness and maintenance are of course management and budgetary issues and not within the purview of an architect's scope of work. Nonetheless cleanliness is a critical concern to design team members and forms part of their first design principle for the proposed facility. The concern about cleanliness and the lack of money available for maintenance is of great concern to design team members. Islam is a religion that is very concerned with cleanliness. Those involved in the design and build phases must be aware of how to address the issue of cleanliness in the choices made regarding design, materials and construction.

- Indoor facilities such as bathrooms must be functioning, clean and sanitary. Stairways and hallways must be free from dirt and debris. Utilities such as electricity, plumbing, air conditioning must be in proper working order and up to actual code specifications whatever they may be. There must be access to clean water, both potable and non-potable for drinking, ablutions, cleaning and as needed for actual class work (e.g. science and home economics classes). The disposal system for the facility should be well designed so that it is easy and direct. Thought should also be provided in designing adequate support facilities such as janitor's closets and stores to streamline the maintenance of the facility on a day to day routine.
- Bathrooms must have adequate lighting, be single sex, and be easy to clean. Doors should provide full privacy; they should be able to be locked and there should be window shutters to allow for privacy. There must be receptacles in girls' restrooms to accommodate sanitary product disposal, a sink and a wall mirror. Providing a handicap stall in both male and female toilets to address universal design guidelines and accommodate any handicap users of the facility.
- Classrooms must be cleaned and maintained to improve indoor air quality.

Obviously spaces and equipment for easy maintenance can be designed, but designers cannot make them clean. It is strongly suggested that USAID work with the FKIP to address this issue of maintenance and cleanliness.

The FKIP design team is already acting on the maintenance issue. As mentioned in Section Six, members have formulated a steering committee to examine this issue of maintenance (in addition to additional issues of technical support, facilities management, security and grounds keeping). Design team members are interested in work-study type arrangements for students, in public awareness campaigns (educating users about littering), in charging user fees to non-education users of the facility and rent to vendors for revenue-generation purposes, and placing signs and trash barrels in the facility so people have a place to throw away rubbish. They are also considering something akin to "Adopt a Highway" programs, where a set of individuals is responsible for taking care of a certain space. However, design team members are busy, underpaid people with competing demands of family and work, and cannot be expected to carry this through on energy and determination alone. We are aware that the DBE 2 program will help administration address issues of maintenance but the most immediate need will be money for maintenance. That said, the following is recommended:

- As cleanliness is such an important issue, we recommend that a small percentage (say, 0.10 percent) of the cost of the building be set aside to hire cleaning staff and have a budget to repair fixtures, locks, doors, windows, etc. of the building.

Money would (and *should*, according to design team members) be kept in a separate account governed by an independent agent outside the University to be used over a number of years. This would allow the FKIP to build some capacity and establish income-generating ways to address maintenance issues.

c. Reconciling Design Tensions

Some of these design elements may appear contradictory or work at cross purposes, for example, it may not be possible to have large windows and conform to seismic proofing regulations.[18] A desire for light may conflict with efforts to keep the internal building naturally cool and with the structural requirements of earthquake proofing the building (presently there are large structural supports on the exterior of the present FKIP facility which obscure interior light). In particular, the need for comfortable temperatures and the need for good acoustics—may collide. An air conditioning (AC) system's effect on a building's acoustics may be overlooked during design because the systems are already a significant building cost, and schools are reluctant to direct higher percentages of budgets away from areas that do not benefit student learning directly. A silent AC system can be designed, but it is an intentional design. Silencing the system involves specially insulated equipment, heavier units to deaden fan noise and larger ductwork to permit the easier flow of air.

Similarly, the need for flexible space may collide with the need for noise remediation. Partitions don't seal off sound as well as walls. (Local engineers suggested filling partitions with "glass wool" or another material of high insulation quality when this concern was raised.) The need for flexible space then will need to be weighted against the need for good acoustics and low ambient noise.

In all of these areas, architects and engineers will need to balance all of these considerations. There are clearly some conflicts and competing interests in this first design principle that need to be reconciled. However, if such tensions or contradictions remain, the following design team priority list benchmarks may help to reconcile these tensions:

1. Structural safety (and all that is required to ensure it)
2. Health and hygiene (good air quality, surfaces that can be easily cleaned, etc.)
3. Flexible space
4. Natural lighting
5. Ventilation
6. Acoustics
7. Comfortable furniture
8. Ergonomic furniture

B. Principle Two: ***The learning environment must support multiple types of learning and activities through the use of sufficient and flexible "multi-functional" space that promotes a variety of instruction.***

Instructional requirements should drive the allocation and fitting out of space. Spaces themselves and the way they are controlled need to be responsive to evolving educational programs, philosophies, delivery methodologies, and student and staff needs. Flexibility in designing learning spaces is critical because learning should occur in multiple configurations—shifting, from an inquiry-based science class where students are working in collaborative groups of four to five persons answering an "essential" question, to larger discussion or seminar groups of 10-20 people, to individual work during the course of a day. The classroom that is designed and the way it is furnished must support all of these configurations.

[18] Engineers at a local elementary school reported that typical Achenese windows are 60 x 120 centimeters, there is evidence throughout Banda Aceh of larger windows. My understanding from (translated) conversations with local engineers is that it is not the size of the window but the strength of the steel window frame that matters.

Both the design of the building and the learning that occur within the building should support instruction that is differentiated. Differentiated instruction simply acknowledges that individuals learn—and therefore must be instructed—in different ways. Some learn best through visual means, others through auditory means, and others by doing a project. Instruction must accommodate all of these individual styles. That is why smaller classroom sizes of 20-30 students are preferable to the current 60-70.

To support such pedagogy, classrooms, libraries, and common areas must be designed in such a way to promote active learning in all its forms, i.e. problem- and project-based learning, collaborative and cooperative learning and inquiry-based learning (see Section Four for a description of active learning). By creating flexible arrangements of space and furniture and through the purchase of shared equipment (laptop carts, for example) and by designing multiple types of "learning" places (cafés, libraries, etc.) student-student and teacher-teacher collaboration and mutual learning can occur more closely and regularly (in part because of availability of shared resources). In this way, the new facility is more than a place —it can create learning networks.

For the initial construction of this facility and its subsequent use, the use and management of space must be responsive to the evolving instructional capacity of instructors as they learn new methodologies, as well as evolving philosophies, and student and faculty needs.

"Flexible" space in this context means one of two things:

- *Convertible* to another use or size (using demountable partition systems can create open, semi-open, or traditional closed classroom configurations). One example is the lobby area of the present FKIP. The lobby has eight to ten thick vertical columns that, though providing structural support, render the lobby space unusable in its present form. By using wheeled partitions to create small, connective areas, one could use the space for an art exhibit or an information area. Another example of flexible space is a round eating area or cafeteria nested within a larger rounded auditorium space. If the cafeteria contains moveable lunch tables and chairs, these can be removed to allow a musical group or small theatre group perform in the space. Thus, the eating area is converted into a performance area.
- V*ersatile*—accommodating multiple functions. For example, a new facility might use the "house" concept, common in large American high schools, in which a central open learning area tech-hub is surrounded by classrooms, or an entry lobby concourse that acts as a multi-use forum for learning and activity space for school and community functions.

Space must be flexible and adaptable enough to accommodate small and large group interactions (from pairs, to groups of three to four to classes of 20, 30 or even 60 students). Furniture should allow for large surface production areas, private workstations, small teaming arrangements and lecture/demonstration teaching and learning formats. There must be sufficient space to allow teachers and students their own space to work and combined space for learning, socializing and individual study. Beyond academic life, the new facility should support the social, recreational and spiritual life of the student and instructors with sufficient space to learn both together and individually, and congregate for social purposes and pray.

While the space itself should be innovative, more important is innovative use of space. For example, hallways—with comfortable furniture or built-in seating along the structures of classroom walls—can become quick meeting spots for students and teachers.

A key strategy for flexibility is, as much as possible, moving away from single-purpose space (there are some exceptions in terms of private spaces, such as teachers' rooms or prayer rooms). Examples of single-purpose spaces include computer labs and language labs whose activities are determined by the type of equipment they possess. If the computers stop working, for example, this single-purpose space becomes a “dead zone.” While science labs—because of their specialized furnishings and equipment—would appear to violate this proscription edict, that is true only in the case of single-use science labs (chemistry or biology), which become the exclusive domain of that branch of science. A multi-purpose science lab, as is proposed in this report, supports sharing of space as well as potential integration of all of the sciences (chemistry, physics and biology).

Similarly, a single-purpose space would be a classroom containing a fixed number of computer workstations in a room (often placed in areas most convenient to technicians and electricians but not students or teachers) dedicating that part of the classroom to computer work alone.

Mobile carts of laptops (four carts with 20 laptops that can be distributed and shared in classrooms as needed) and VSAT-connected wireless access eliminates most of the need for single use spaces (the exception is the library which will be discussed later in the next section). Creating a small mobile field of computers will allow various configurations of students to share information in many different spaces throughout the facility. Flexibility can also achieved by scattering electric outlets throughout the rooms, and installing a wireless network.

Reduction in classroom size (from the standards 9 x 7 meters which typically accommodates 60 students) to varying sizes rests on the assumption of smaller class sizes (instructors advocated for a maximum of 20-30 students per class) and the assurance by faculty that there are enough instructors to teach all students given this reduced class size. But by designing classrooms to be convertible (using partitions with glass wool or sound absorbing insulation interiors and movable furniture) and versatile, classrooms can be expanded or contracted to allow for a larger or smaller numbers of students as the instructional activity, course requirement and event dictates. Therefore, space will not determine the type of instruction students receive (as is presently the case). Rather the type of instruction will determine how much and what type of space is needed.

C. Principle Three: ***The learning environment must inspire students and instructors to higher “levels” of learning, including facility with 21st century technology tools, application of knowledge, creativity, analysis and problem solving.***

It has almost become a cliché to say that the world of work has changed—but it has (which in part is why a new facility is under proposal). Today’s FKIP students will become Aceh’s teachers of tomorrow and they must possess certain skills—the ability to apply conceptual information to new situations, solve problems, be creative, intellectually flexible, communicate in a variety of formats, and facility with technology tools. In short, they need to develop higher order thinking skills so they can foster these same skills in their students.

To help FKIP students—the future teachers of Aceh—develop these skills, the new facility must include the types of resources and equipment students will need to become a “21st century teacher.” This includes access to laptops (we propose 80), a wireless connection for the school to provide students and their instructors flexible Internet access that is not contingent upon being in a certain space, and access to the most up-to-date comprehensive information in the form of ten library terminals that act essentially as a virtual library with access to online libraries (free and subscription service). The classroom spaces in which these tools will be used will need to be designed in such a way as to support the integration of technology within content areas. This includes among other things, tables with large enough surfaces on which laptops can be placed, moveable furniture so multiple students can work together on one laptop, and distributed power outlets so student work space isn’t bounded by infrastructural constraints.

Students also need access to a modern and well-functioning science lab. There is not enough funding for separate laboratories, given the budget for the facility, but a comprehensive multipurpose science lab, to be shared among biology, chemistry and physics students, can greatly enhance the scientific knowledge and scientific thinking skills of students. The specifics of this lab, and the equipment it will need, are included in Appendix One.

However, all of these resources and equipment will be ineffective unless grounded in good teaching. Computers cannot make a bad teacher better. And computers, if used in lower order ways (for Internet searching without questioning the veracity of the information found; for creating bulleted lists of information versus genuinely wrestling with the writing process) will not help students attain higher order skills.

If higher order thinking is a main goal of instruction, instructors themselves will need to become critical thinkers. They will need to learn, not just how to help students find and communicate information using the Internet, but how to evaluate the veracity of this information, reason logically from this information, come to evidence-based decisions, analyze the merits and demerits of these decisions, create new knowledge based on this reflection, and apply their learning to new situations. This may involve the use of computers, but computer use is not the goal. The goal is that students (and instructors) become *creators* of information not simply *users* of technology.

For this to happen, it will not be simply enough in professional development how to teach instructors how to use technology, they will need to learn how to integrate it so it deepens subject area understanding and develop critical thinking about the role and utility of computers as a learning tool.

Thus, the professional development instructors receive will need to foster an intellectual environment in which teachers address not just the lower order "what" and "how to" questions that accompany technology professional development, but the higher order "how," "why," and "wherefore" questions that prompt real understanding of the true potential and best use of computers in instruction. This professional development will need to help instructors understand how to use the new space and resources in ways that promote the 21st century education in a 21st century facility.

D. Principle Four: ***The learning environment must create a greater sense of community within the school and in the larger educational community. Space should be designed in such a way to be responsive to the ever-expanding educational needs of the community the building serves.***
The communities the proposed facility will serve are as follows:

a. FKIP Students, Teachers and Administrators at the Main UNSYIAH Campus
Personalized relationships demand smaller class size, allowing for greater individualization of instruction and more frequent and meaningful teacher-student and student-student interactions. Personalized relationships also demand places where people can discuss and socialize on an informal basis. By cultivating these ongoing relationships, community formation can begin to take place.

The design and arrangement of interior space should prompt teachers and students toward closer relationships by allowing them to interact more closely (for example, a flexible furniture arrangement can eliminate the fixed location of the instructor behind his/her desk, allowing for greater interaction with students). The design of the new facility then should prompt greater teacher-student-administrator interaction where supportive informal actions become the norm. This will be a challenge for a facility that will serve anywhere from 4000-6000 people. (Refer to Table One in Section Two for FKIP population data.)

Small spaces (e.g., window seats, flexible size classrooms, seating areas built into corridors, small alcoves that accommodate two to three people, central courtyard and food areas) can allow teachers and students to gather in small groups or pairs, to discuss, share ideas, eat, drink and simply converse. All “residents” of the new facility must have access to any and all available space, from hallways to classrooms.

b. FKIP Students, Teachers and Administrators at the Satellite Campuses
The new facility is not just for instructors and students at the main FKIP campus, but for the 2100 students and 64 instructors at the two satellite campuses—Go Heng and Lampeuneurut. All facility events must be communicated to instructors and students at these campuses and primary school teacher training faculty classes scheduled at the new facility.

c. Students, Teachers and Administrators from Other Faculties at the Main UNSYIAH Campus
The new FKIP facility is the anchoring institution for UNSYIAH as a whole. In some ways it is the symbol of post-tsunami survival as the present FKIP was the only UNSYIAH building destroyed in the tsunami. As such, FKIP students and teachers welcome all UNSYIAH members to its library, lab, and other public areas, such as classrooms and café.

The new FKIP facility should be able to offer something new and useful to the university. There are many ways to do this:

1. Relocate the university library to the new FKIP library
2. Schedule a certain amount of non-FKIP classes in the new facility
3. Set up cross-department classes that can be held in the new facility (e.g., chemistry could be taken for science credit or education credit and classes held in the proposed multi-purpose science lab)

4. Establish a Testing, Measurement and Evaluation Center at the new facility to be used by all UNSYIAH departments. Presently, while the university surveys the capacity of its staff in these areas, the center could be intended space, to be used for other activities in the interim. As the university develops the capacity of its instructors in this area, the center can eventually begin to take physical shape and provide service to the whole university community.

d. Students, Teachers and Administrators from Other FKIPs (Muhammadiyah and IAIN)
The facility should be used as a mechanism to foster greater academic integration and mutually supportive networks between the Unisyah FKIP and FKIPs from Muhammadiyah and IAIN. The new facility should be a place where students from other universities can take classes and share resources (as in an open enrollment system or with class space “reserved” for a certain portion of students from other universities).

e. Students, Teachers and Administrators from Area Primary and Secondary Schools
The facility should be used as a mechanism to foster greater academic integration and mutually supportive networks between the FKIP and local schools. The new facility—as well as its teacher and students—must be seen as a resource to local schools and in turn see themselves as a resource. The UNSYIAH FKIP is the largest “producer” of teachers in Aceh Province but there needs to be greater association and collaboration between the FKIP and the schools its graduates will serve. This sort of resource sharing and collaboration can occur in part by encouraging local schools to hold classes in the new science lab and library, by offering technology training to teachers and students from local schools, and by FKIP instructors regularly visiting, observing and working in the schools whose teachers they help to form.

f. The Community at Large.
The new facility must also make available ongoing and continuing formal and informal education opportunities for the university’s neighbors—through concerts, discussion groups, computer classes, art exhibits, etc. The facility should be accessible—available and able to be utilized by anyone with a legitimate educational purpose. Common spaces, such as exhibition rooms, should be located on the ground floor of the new facility so they are easily accessible.

Events must be publicized and communicated to UNSYIAH's neighbors (businesses, residences and other institutions). As much as possible, exhibits should be organized as outside events to promote accessibility and help community members feel free to "drop in" on an event.

It is not clear how evolved formal discussions about collaboration are at this point beyond assertions and good intentions. We return to this subject again in Section Nine.

Figure 21: An example of accessible design is this non-grip door handle that makes for easier opening.

It is critical here to discuss the principles of accessibility and circulation (movement of people) in more detail.

e. Accessibility
Accessibility does not simply involve invitations to the proposed facility. Accessibility means designing the facility, particularly its public spaces, in such a way that they are easy to find and easy to reach. But accessibility has a third meaning—that the building be designed with Universal Design principles in mind. Unlike *Americans with Disability Act* (ADA) compliance (where structures are designed specifically for people with disabilities), a Universal Design Approach aims to create space that can be used by all. A universal design approach advocates for equitable use of space that is flexible, simple and intuitive, that involves low physical effort and has tolerance for error (mitigating and minimizing hazards). Thus, it is recommended that the new facility contain ramps from the first to third floor, that it avoid door knobs (in favor of easy-to-grip handles—see Figure 21) and that doors are made wider to possibly accommodate someone in a wheelchair. Handrails and toilet fixtures should also be designed to accommodate handicapped users of the facility.

It is also recommended that designers check to see if they are required, because of funding from a U.S. government agency, to comply with the *Americans with Disabilities Act.*

f. Circulation
Stair risers and treads should follow the design code guidelines. The number of risers should also follow the prescribed guidelines of not more than twelve risers per flight. The width of staircases and corridors should conform to the minimum requirements as prescribed by the local design codes and specifications.

E. Principle Five: *The learning environment should be a place of beauty that instills pride in being a student and teacher at the FKIP, a sense of ownership among students, instructors and colleagues from surrounding schools*
Architecture represents the vision, values and ideals of a particular community. The new facility also serves an important psychological function—hopefully generating a sense of pride and self-esteem among FKIP students to attract and retain a better quality of pre-service teacher candidate. Students and teachers must not only be thrilled about their new building but it should inspire them to do their best work and enhance the teaching and learning experience.

As such, the new facility, as we have mentioned, must foster community, comfort, aesthetics, performance, collaboration and privacy. All shapes, form, colors, textures, and design elements should have a design ingredient.

Classrooms should conform to the highest standards of human values (aesthetics, psychology, community spirit, happiness, and joint partnership). As much as is possible, given monetary constraints, the facility should be beautiful. Materials and craftsmanship should be of the finest quality. Walls should be adorned with photographs (of natural scenes, of architecture, of locations in Aceh) that are beautiful and inspiring as well as with inspirational examples of instructor and student work. If craftsmanship and budget allows, the building should be fitted with the traditional woodwork (such as Acehnese doors), design, calligraphy and filigree that evokes the strong sense of Acehnese culture and the Islamic faith. Gardens and outer areas should be places that inspire a sense of beauty and tranquility. In short, the facility should make both FKIP and UNSYIAH students and their instructors proud and it should make residents of Banda Aceh equally proud.

VIII. Design Guidelines for the Learning Spaces/ Environment

This section describes in greater detail the design guidelines, in terms of space, furnishings and equipment, needed for the proposed FKIP facility. This section discusses the previously identified "priority areas" (see Section Six) as well as additional spaces discussed during the participatory design process.

A. Classrooms

The classroom is the main unit of focus at the proposed FKIP facility. It is the main priority for the proposed campus and the locus for direct instruction of content, concepts and skills. The classroom, more than any other space, supports the learning process by assembling a group of learners, often with diverse learning styles and needs, to focus on a particular area of study. The classroom is one of the few school spaces proposed here that does not require specialized equipment or infrastructure. It is a general purpose learning space, the main "function" of which is to be versatile enough to facilitate the learning demanded by a certain activity and to accommodate the greatest variety of teaching and learning styles possible.

That is not to say that there are not uniform requirements that should be common across all classrooms. Since students and teacher spend most of their school days in classrooms, their design is absolutely critical to the teaching and learning process.

Teaching and learning at the proposed FKIP facility is intended to move away from traditional rote and lecture-based formats to more active learning and classroom space must reflect this change. Therefore, the space should accommodate a variable number of learners, ideally 20, but possibly 60 if scheduling and teacher shortages demand. The space should accommodate a variety of activities, including: large group instruction (of 20-30 learners); small group instruction (four to five students per team); and project-based activities oriented toward real-world research, collaboration, communication, the use of higher order thinking skills, using and manipulating technology, during which students may leave the room to take outside photographs or share a laptop (one among several students or pairs) to create a final report. The space should accommodate individual desk work, lecture, large group discussion, debates (in which students sit opposite one another and discuss issues), role playing, the display of projects, quiet reading—in short, any type of instruction imaginable. It may eventually even need to accommodate multi-disciplinary instructional activities where two to three classes (e.g., science, home economics and math) collaborate on a project-based activity.

a. Layouts

Thus, classrooms must be flexible—designed to accommodate varying numbers of learners, various activities, and easy circulation between furniture layouts. Rooms should be separated by moveable partitions (with good insulation provided by "glass wool" or noise absorbent insulation) to allow classrooms to be expanded or contracted as instructional needs and scheduling demand. The partition should be of a light enough color so that it can also be used as a screen for overhead or LCD projector displays. Where classes are small—and the design team will gladly accept smaller spaces than the standard 9 x 7 configuration if they have fewer students— instructors can make up for diminished space requirements by using mobile technology (laptops, TV, LCD, etc.). The entrances to the classroom should accommodate for the flexibility desired in dividing the spaces depending on instructional needs.

Furniture must be flexible (easy to move and arrange into shapes), modular to support various types of student group formation, and have different sizes of work surfaces such as those provided by flat tables, work tables or benches. Furniture should also be durable, comfortable and ergonomic where possible (at the very least we recommend straight back chairs for lower back support). There should be tack boards on which to display artifacts, learning materials or student work; wheeled white boards on which teachers and students can write (with erasable markers) that can be moved around the room to avoid glare; and waste baskets or small trash bins so that instructors and students will treat the room with respect by throwing away their trash, versus leaving it behind.

"Fixed elements" (such as a teacher's desk and ceiling mounted projectors) must be kept to a minimum so as to not encourage a traditional "teacher in front of the classroom" mode of instructional delivery. Related to this, and over the objections of design team members, we recommend ceiling-mounted projectors only in rooms to be designated as lecture spaces with one portable projector to be given to each of the seven FKIP faculties so as not to encourage the traditional "stand and deliver" mode of instruction that occurs with projectors and especially PowerPoint presentations.

Infrastructural fixed elements, however, such as fixed storage space like cubby holes for student backpacks and distributed electrical outlets along walls for easy plug in of computers, should be considered.

b. Accessibility
There should be easy access to resources, other learning areas (library, outside space, labs, and other classrooms). Electrical power outlets must be located throughout the room so that students are not confined to a fixed place to work. There should be sufficient lighting for optimal student performance (the design team recommends exterior and interior windows[19] so that the classroom is visible from the hallway, providing a greater sense of openness and a visual link between interior and exterior spaces), multiple exits (i.e., more than one door but doors that are wide enough to allow laptop carts and TVs to pass in and out of the classroom and to allow classrooms to be flexibly divided without interrupting classroom occupants), low ambient noise from outside the classroom, and cross-ventilation to keep temperatures cool.

Certain spaces in the classroom should be reserved for individual, quiet or reflective work as needed. One recommendation is a small carpeted reading area with inexpensive comfortable chairs or the low chairs found at Acehnese coffee houses, separated by the main area of the classroom by a small bookcase or some sort of furniture boundary. This sort of request might be challenging given the demand for partitions and convertible space but it should be explored in the design process. The classroom should also provide informal and semi-private learning spaces such as window seats built into the structure allowing students the opportunity to sit by the window and study, discuss or do semi-individual work.

c. Space Adjacencies
Adjacencies are extremely important in the location of classroom spaces. Related spaces, such as the classroom and libraries or classroom and science lab, should be near one another. Facility planners (i.e., those doing scheduling and rooms) should consider the placement of classes—should all guidance and counseling classes be located near one another or should all FKIP faculties be "spread around" for greater potential interaction among faculties and departments? Non-related spaces (classrooms and student activity areas) should not because of issues of ambient noise or a heavy flow of outside human traffic that may prove distracting to students inside the classroom. As a safety precaution, locate as many classrooms as possible (and other large "population centers," such as the library) near stairs. In the event of an earthquake, the safest areas are within 40 meters of stairs.

UNSYIAH engineers estimate the need for 20 additional classrooms (*ruangs*) with capacity for 30 students and 7 lecture halls (*aulas*) with a capacity to hold 60 people. Specifications are provided in Table Four as guidance to designers. The engineers were not part of the design process and these data are based on a prior need analysis included in the FKIP's original

[19] Interior windows increase the ambient noise from the halls. Special acoustic installation should be used to overcome this increased noise.

proposal for a new facility. These specifications are a useful estimate of the space needed, but must be re-evaluated in light of the design team's stated preferences, particularly their desire for flexible space with partitioning, a need for storage and a lack of fixed elements and storage space.

Table 4: Area specifications for classrooms in proposed FKIP facility

Student Capacity	Number of Classrooms Needed	Area need/unit	Total Area
30	20	60 m^2	1200 m^2
60	7	120 m^2	840 m^2
Total	**27**		**2040 m^2**

These specifications do not take into consideration the fact that at least three rooms that we know of in the present FKIP facility—administrator's office (and adjoining spaces), the science laboratory, the teachers' room—will be moved to the new facility (there may be more). Therefore, these numbers must be interpreted in light of three factors:

1. They do not take into consideration the space in the *existing* facility that will be freed up for classrooms with the creation of the new facility
2. They do not take into account teachers' desire for "flexible" space, where through the use of partitions, classroom space can be created as needed, depending upon the size of the class(Engineers numbers are based on a traditional fixed measurement of classrooms)
3. They are contingent upon the final footprint size of the actual facility. This has not been determined definitively because certain factors (regulations governing parking, the exact size of the building coverage ratio, and the actual design of the building, have yet to be determined)

The proposed FKIP facility is designed for innovative uses of space. More "traditional" activities, such as lectures, can for now be housed in existing FKIP classrooms.

Designers might wish to investigate the use of "learning clusters"—clusters of 5-6 classrooms around informal areas which may be also used as flexible spaces for spill out as well as a varied learning experience.

The cost of all equipment and furniture for new classrooms is $ 200, 475. Costs are detailed in Table Five.

Table 5: Cost of Classroom Furniture and Equipment

Types	Details	Per	Unit Cost US $	Total Cost US $
FURNITURE	Instructor table	unit	50	1350
	Student's desk*	unit	100	20200
	Lecturer's chair	unit	50	1350
	Student's chair**	unit	50	40500
	White board	unit	100	2700
	Trash barrels	unit	5	135
	Display board	unit	35	1890
Total Furniture				**$68125**

Types	Details	Per	Unit Cost US $	Total Cost US $
ELECTRONIC	6 trolley each 20 laptop (P4, RAM 512, HD 80 GB, DVD CDRW Combo Drive, Blue Tooth, Infra Red, Wireless, Internal Modem)	unit	1000	120000
	Subject specific software (1 set for each department)	unit	250	1750
	LCD Projector (NEC VT47)	unit	1300	9100
	Screen	unit	200	600
	Overhead Projector	unit	300	900
Total Equipment				**132350**
Total Furniture and Equipment				**$200475**

*Amounts based on 30 students x 27 classrooms *30/4 x 27 classrooms=202 tables * *30 x 27 classrooms = 810 chairs All prices are subject to change*

It is important to briefly discuss the contents of Table Five. First, the cost of student chairs is high. In one school visited, chairs were estimated at $16 a piece (versus $50 here). However, it is important that students have as ergonomically correct chairs as possible (at least chairs wit a straight back) and these will be more expensive than fold-up chairs, for example. The $50 cost allows for this padding. The $50 cost also compensates for some items we were unable to cots such as partitions between classrooms, shutters and window seats.

Second, we advocate the purchase of only three screens (for projection purposes) as lightly colored partitions can serve as good backdrops on which to project images, slide shows, etc.

Third, we suggest providing one laptop cart for use by each department—six carts in all (This does not include a laptop cart for the primary school teacher training faculty who are off site. This raises immediate equity issues) to be stored in the library. We also suggest providing each department with the equivalent of $250 worth of subject-specific software (math activities, etc.) that can be installed on "their" laptop carts. Although the primary school teachers will not receive their own laptop cart, a set of primary age software should be installed on one of the laptop carts as there is abundant and good software for primary school education.

B. Multipurpose Science Lab

Unlike a classroom, a multipurpose science lab is the epitome of specialized space. Science labs are "zoned," as it were, for specialized activities. The lab itself and structures within the lab allow students to develop and practice specialized skills such as scientific inquiry, formulating hypotheses, empirical research, experimentation, observation and recording. Fixed elements, such as lab tables, sinks, etc. provide a basic structure and infrastructure for learning that can be completed by the student according to activities and needs.

In keeping with earlier stated priorities of advocating for the common good and creating, where possible, multi-purpose space, the design team proposes the creation of a multi-purpose science lab to be used by biology, chemistry and physics classes, not just within the FKIP but by students at IAIN and Muhammadiya, as well as students from local areas high schools. It is important to note that the equipment purchased for the proposed FKIP science lab must be similar to that used in schools.[20]

[20] As part of tsunami relief, local area high schools have received new science lab equipment. These teachers complain that FKIP graduates (i.e., new teachers at these schools) are unable to use this equipment because it is not similar to that used at the FKIP.

Figure 22: Flexible science furniture that can be used for laptops, experiments, small group work and individual work. Because it has wheels, it can be easily moved aside or stored when not in use.

Though the space is different and more specialized, similar design considerations prevail for the lab as with classrooms. For example, lab space, furnishings and equipment must be versatile. Furniture must be flexible to accommodate a variety of student groupings (pairs of students sharing a microscope), group work, and individual journal writing, for example. (See Figure 22 as a model of the type of flexible furniture envisioned for the lab). Equipment must be flexible so it can be moved and stored to make way for another branch of science, though fixed core elements such as sinks can remain. However, to guard against potential hazards because of the frequency of seismic activity, all lab equipments and supplies must be securely stored in storage and display cases that are built into the interior walls (versus free standing cabinets) of the lab. when not (and perhaps even when) in use. Display cases for specimens may be inbuilt as it would reduce the possibility of damage during seismic activity as compared to free standing cabinets. There should also be a small office space for a lab assistant with an attached storage space for extra supplies.

Second, the lab must accommodate a variety of learning styles and activities. Furniture must be arranged so students can easily reach supplies and equipment and so that instructors can easily reach students.

Science is a priority subject area for the FKIP and the science lab a priority need for the proposed FKIP facility. We therefore recommend that the lab contain an Internet-connected desktop and be provided with science software so that experiments that cannot be undertaken because of a lack of equipment or funds can be done virtually—either online (there are numerous free, online, interactive science sites) or digitally (software). We also recommend that the science lab have a ceiling mounted projector or a fixed projector connected to the PC desktop to demonstrate appropriate experimental techniques for students.

The lab should also house the one digital camera that will be purchased through technology fund. This high resolution, eight megapixel camera, with adjustable lenses, will be used by science classes but will also be shared (through checkout) by other classes as needed. The camera may not be used by students or by teachers for personal reasons.

Figure 23 provides an example of the type of lab space FKIP design team members (in particular the science teachers) would like to see in the new facility.

Engineers' estimates of lab space do not correspond to the notion of a multipurpose lab. Engineers did create estimates of separate lab space—chemistry, physics, biology, etc. that totaled 1840 square meters. Within that total, the chemistry lab was envisioned as, 360 square meters, a physics lab at 240 square meters, and a biology lab at 120 square meters. Again, these estimates are not aligned with the final decision to create one multipurpose science lab. They are provided here, however, to give designers an idea of the size of space engineers believe is needed.

Figure 23: Optimal lab arrangement includes tables for experimentation and writing, sufficient equipment, storage space, natural and artificial light, and provision for sufficient water and electrical outlets.

The total cost of furniture, supplies and equipment is $11,462. Of this, subject-specific supplies equipment for biology, physics and chemistry is estimated to be $185,505. (Due to its length, that list is provided in the Appendix of the report.) The cost of furniture for the multipurpose lab is estimated at is $ 25,957. Details of furniture costs are provided in Table Six.

Table Six: Furniture Costs for Proposed Library

Detail	Unit	Amount	Unit Price (USD)	Total Cost (USD)
Students' station	pcs	5	620	3,100
Wall bench	pcs	2	1.161	2,322
Preparation table	pcs	2	1.450	2.900
Chemical storage	pcs	3	535	1,605
Storage cabinet	pcs	4	320	1,280
Laminar flow	pcs	2	3,600	7,200
Fume hood	pcs	1	4,496	4,496
Fish Tank	pcs	2	500	1,000
Ticket window	pcs	2	400	800
Sink basin	pcs	4	75	300
Buret sink / deep sink	pcs	1	15	15
Peg board / draining rack	pcs	2	300	600
Stool	pcs	25	10	250
Softboard	pcs	6	15	90
Total				**$25,957**

The above costs were calculated with the assumption that the new lab will be able to use much of the existing furniture from the existing lab (desks, chairs, cabinets, file cabinet, etc.)

The cost of technology equipment is $3,880. (This does not include the cost of laptop cart for the lab or the In-Focus projector. These are included as part of the classroom costs.) Table Seven provides a detailed overview of technology and equipment costs for the proposed science lab. The total cost of equipment and technology is estimated at $3,880.

Table 7: Estimated Technology Costs for Multipurpose Science Lab

Detail	Unit	Amount	Unit Price (USD)	Total Cost (USD)
Personal Computer[21]	set	1	800	800
Camera (Canon EOS-350D + Lens)	pcs	1	900	900
Printer	pcs	1	250	250
Air Conditioner	pcs	2	650	1,300
Exhaust fan	pcs	4	20	80
Refrigerator (2 doors)	pcs	1	350	350
Water purifier (or water dispenser, hot and cool; for drinking station)	pcs	2	100	200
Total		**12**		**$3,880**

It is necessary to mention a few words about these costs. First, because of the substandard quality of science equipment, we have included costs of new subject-specific equipment (test tube holders, etc.). Second, we have included the cost of laptop cart with 20 laptops and the cost of an In-Focus projector as part of classroom costs (with the assumption that laptops and the In-Focus projector will be used in both the multipurpose science lab and science classrooms. (Additionally, the idea is that though each department receives a laptop cart, they would share laptops with other departments when not in use.) Third, where possible, we have eliminated the cost of all materials and supplies that were deemed either “unnecessary” or “easily purchased” (such as gauze, rubber gloves, etc.) This winnowing process was done in consultation with science, chemistry and physics teachers in the U.S. and through a process of prioritization by FKIP science faculty.

C. Library

The library is, in many ways, the heart of a university and contributes to the overall academic quality of an institution. In addition, the library is and should be, a major part of students’ university academic experience as a place for study, to conduct research, read and reflect. Students and teachers should be able to gather the most current and relevant resource and reference materials, as well as subject-specific journals and materials, information on all matters related to teaching and learning, and news and information.

Library materials now include many non-print media formats — CD, audiocassette, videotape and DVD—and should do so at the proposed FKIP library. These materials are fragile, and the technology required to play them may become obsolete in the near future, but they are popular

[21] Intel P4 3.2 GHz, HDD 80 GB Sata, RAM 1 GB Visipro, VGA 128 MB, LAN, Sound Card, Chassing 2 USB Front, Motherboard P 915 GL,DVD Combo, Floppy Drive, Monitor LCD 15"

because of their multimedia attributes and they have the advantage of requiring less floor and storage space and being much easier to update than standard book and print materials. These new media will provide a challenge in terms of how they should be integrated into the collections and also in terms of how they are made accessible. FKIP will need to weigh whether to keep these materials as a reference collection for viewing only in the library or for borrowing (a fixed number of days with fines for late returns).

Since the FKIP is probably not likely to be able to purchase new print-based materials, technology in general and the Internet in particular can be a useful substitute for and supplement to print materials. Each day, library staff or instructors can print out periodicals (as an example), make multiple copies of (e.g., the *Jakarta Post or Kompas*) and create copies for library use.

The focus of an academic library must be not be only internal, but also forward and outward, serving both the FKIP and UNSYIAH communities. Certainly, UNSYIAH administration has

Figure 24: The design team chose this photo as an example of the kind of library space they would like to see—rounded, soft areas for conversation, books interspersed with computer resource tables (virtual library) and gathering places to work collaboratively.

expressed the view that the library might be a place that brings together the diverse members of the UNSYIAH community. But the implications of this for space and design must be carefully considered (It is not clear that these discussions have occurred nor was the consultant able to meet with UNSYIAH rectors about this issue during her visit.)
If the FKIP library is to be designed for use by potentially all UNSYIAH students, the library could, potentially, be serving, upwards of 10,000 students—a conservative estimate. If the FKIP library is reserved for FKIP students and teachers alone it could service approximately 6,000 students.

The growth and evolution of the library will be dependent upon the university leadership — student, faculty and staff — working with the library administration to create a place that can benefit the entire community. For that reason, the university should discuss whether the new library should serve education needs exclusively or the multidisciplinary needs of the whole university community.

Whatever the final dimensions, the overall organization of a library should be clear and easily understood. It should indicate private places for reading and reflecting and demarcate small private class areas (e.g., glass enclosed rooms where an English instructor can wheel in a TV for

Figure 25: Another attractive configuration. Research terminals are placed in their own designated space partitioned from an area used for small group study.

English-language broadcast purposes and hold class for up to 30 students.) Navigation should be made easy through signage or landmarks. Figures 24 and 25 demonstrate elements and arrangements of space that the FKIP design group found attractive: circular seating arrangements for close and quiet collaboration; the virtual library (in the form of computers); different systems for shelving; different types of lighting or seating that make the space unique and distinctive (softer light for individual spaces, fluorescent light for public areas); comfortable sofa sets that encourage students to stay and read; small tables and an exterior space for collaborative study; and carpeting to mute sound. The entrance to the library should provide storage or locker space for students to store backpacks.

The online library of which we speak here would consist of three components:

1. *Internet*—though with certain sites filtered, such as web mail sites, so that students and instructors do not use the terminals as communication spaces. These would be dedicated research stations.

2. Research specific software, such as *Encarta*, *Encyclopedia Britannica* and other software-based reference tools

3. Subscription to an online library. Students and instructors would have a login name and password to allow them to access the online library from anywhere around the FKIP facilities. Thus, one could be "at the library" at the café or in a classroom.

Figure 26: Secure iron doors can be used to reinforce interior set of doors to prevent against theft of equipment. Double doors are recommended to allow for ease of entry and exit of users and equipment.

In addition to being an area for research, the library should serve as a media center. For that reason, all media (TVs, laptops) as well as two-three printers and copy machine (for use by students for a fee and for teachers via an access card or code for instructional purposes only) should be stored in the library. Mobile technologies (laptops, TV and overhead projectors) must be securely stored in a secure storage area. All equipment should be secured to the structure when not in use to avoid its coming loose in an earthquake. The windows and doors of the library should be protected by metal grills for security purposes (See Figure 26). This media area will need space for a media specialist who monitors the use of equipment, possible training in equipment use, and scheduling. Designers might also wish to investigate using automatic door openers (as is used to allow wheelchair users to enter a facility) to make it easier for laptop carts to enter and exit the library. Finally, the library should be accessible to instructors and students on weekends (there is some discussion about whether this could e in the form of a weekend internet café where email access is allowed and a small fee charged to supplement recurrent library costs.)

Engineers estimate that the proposed library at 1500 square meters, but this specification needs to be re-examined in light of high level administrative conversations. Again, who is the intended clientele? Is it open to all of UNSYIAH or just the FKIP? Is it open to all FKIPs in partner universities? How many daily users does the library expect to have? Is it single or multi-story? Despite the stated goal and best intentions around making the facility (and library) a community space, a unifying space, these sorts of quantitative decisions must be made. It is not clear that they have occurred and it was not possible to have such conversations during the course of the week in Banda Aceh.

It is not possible to estimate the construction cost of the library until UNSYIAH and FKIP administration decide on the actual clientele the library will serve. If it is exclusively for FKIP, it will obviously be smaller than if it is intended for all UNSYIAH students, teachers and students from local primary and secondary schools, and students from IAIN and Muhammadiya.

The cost of library equipment and furniture for the library is estimated at $42,305[22]. Table Eight provides a breakdown of these costs.

[22] This does not include security measures such as grilled doors or windows or automatic doors.

Table 8: Cost of Library Equipment and Furniture

Types	Items	Per	Quantity	PRICE/ UNIT* US $	US $
FURNITURE	Book rack	unit	10	350	3,500
	Books	set	1	2.000	2,000
	Shelf	unit	5	400	2,000
	Conference table	unit	3	150	450
	Sofa set	unit	5	1.500	7,500
	Chairs (librarian, assistant and tech support person)	unit	3	100	300
	Desks (librarian, assistant and tech support person)	unit	3	200	600
	Small table and chairs (pair or small group study)	unit	10	100	1,000
	Computer tables and chairs	unit	5	120	600
	Display board	unit	3	35	105
	Locker 30 doors	unit	2	700	1,400
	Total Costs				**19,455**
ELECTRONIC	PCs (research and typing)	unit	15	800	12,000
	Research software (Encyclopedia Britannica, Encarta)	license	1	2.000	2,000
	Printer (HP laser jet)	unit	2	250	500
	Scanner	unit	1	250	250
	Air conditioner	unit	2	400	800
	Headset	unit	40	25	1,000
	TV	unit	3	250	750
	Cart (TV)	unit	1	50	50
	Mesin Foto Copy Machine	unit	1	5.500	5,500
	Total Equipment				**$22,850**
Total Cost Furniture and Equipment					**$42,305**

D. Prayer Room

Because regular intervals of daily prayer are an important part of daily life for instructors and students, special care must be taken in the construction of a prayer room (musholla). This importance can be seen in the comparative degree of specificity in this description.

Figure 27: Students wash their hands, feet and face before praying. This wash area is located near a prayer room that exits onto an outside area.

The prayer room must be located in the western part of the building to allow those praying to face Mecca (west of Indonesia). The room should be 9 x 8 meters with two separate entrances to allow for males and females to pray separately. Hooks should be placed along walls to allow individuals to hang their belongings. Each section of the musholla should have a window and the floor should be carpeted. There should be an area adjacent to the prayer room to allow those praying to wash their hands and feet. This might be a wash basin or the type of wash area indicated in Figure 27. These wash areas should be separate for males and females. Though instructors and students professed an interest for a prayer room in the interior of the building, these cleansing requirements may necessitate its being placed near an entrance or exit of the building or near restrooms or may require the creation of a separate prayer room structure outside the building.

Engineers estimate that prayer room at a size of 60 square meters. We do not have costs for the prayer room. These will be minimal, carpeting and a wash area.

E. Gathering Spaces

Non-classroom spaces—such as hallways, eating areas, study spaces, a student lounge or community room and outdoor spaces—provide space for socializing, gathering, and impromptu meetings with friends or learning opportunities. Some of these more formal gathering spaces have been discussed previously (see Section Six for a discussion on the café, garden area and courtyard). Transition spaces (such as corridors and hallways), nested spaces (such as window seats, benches built into the structure of the building or classroom exterior walls) and informal public spaces (such as the lobby), can also serve as gathering spaces for different purposes. If designed properly, with elements (such as seating areas) that encourage people to stay and visit, they can support socialization and integration of learning. We will not elaborate on the design of these spaces except to suggest that they must be carefully considered in the design of the new facility, be designed in such a way that they are pleasant, comfortable and encourage people to linger and visit, and that one of their main functions be to encourage socialization, informal collaboration, and informal learning. These spaces are generally a by-product of the design but we propose that careful thought be put in these intermediary gathering spaces to enhance their quality and character.

The cost of the outdoor café is an estimated $1,500 (a set of ten covered tables, each with four chairs). Otherwise, we have not included costs for these gathering spaces.

F. Private Spaces

Conversely, escape spaces such as outdoor seating areas and small study rooms can help students and teachers get away from group activities or formal learning activities. Such spaces allow individuals to take a break, decompress, rest, relax, or reflect.

Figure 28: In addition to libraries, teacher rooms and student rooms, students and teachers need private areas for quiet study and reflection.

The new facility must provide for these escape or private spaces, such as the one shown in Figure 28. Private spaces can even be public spaces that are available “after hours” or at “off peak” times, again as in Figure 28, which is clearly designed for public use (possibly at a meal time or during a scheduled set of activities) but that can be used for private study or “down” time.

These private spaces must be designed so that they are secure and safe—with sufficient lighting multiple exits and within line of sight of other areas and individuals. They should be comfortable enough (with chairs or seats, possibly tables, providing green space and ventilation) that they encourage individuals to visit the space and to keep returning. Finally, they should be small in scale so that they encourage private or semi-private, versus large group, use. This can also be achieved by the interior furniture layout with the use of medium height partitions. These spaces may be a part of the library, teacher staff room and study halls for students.

Designers should think about locating several small group study spaces on each floor for teachers and students.

Table Nine lists prices associated with these private spaces. Note that many of these private spaces may be public spaces that are concerted to private spaces during “after hour use” and therefore may not need much in the way of additional furniture. The costs listed in Table Nine can also cover furnishing costs for these additional, non-defined “public” areas.

Table 9: Costs for Private Spaces

Types	Details	Per	Quantity	Unit Cost US $	Total Cost US $
Furniture	Sofa set	unit	5	1,500	7,500
	Display board	unit	2	200	400
	Table	unit	4	500	2,000
	Chair	unit	4	25	100
Total					$ 10,000

G. Teachers’ Room

Next to the classroom in which they teach, the teachers’ room is probably the most important space for the 264 FKIP instructors on the main UNSYIAH campus. Here, teachers meet with colleagues, plan lessons, potentially visit with students, conduct research, grade papers and exams, visit with colleagues, practice computer skills, relax and unwind.

The room should be designed to allow for all of these activities to occur simultaneously for various groups of teachers. Not all 264 will occupy the room at the same time, but the space should be able to comfortably house up to 50 people (we anticipate that only a small percentage will be in the teachers’ room at any one time. The room should be designed in such a way that it encourages collaboration, integrated planning, formal and informal discussions, sharing of expertise and team teaching. Though the room cannot hold all 264 instructors at once,[23] there should be along an interior wall enough cubby holes or pigeon holes that all instructors can store unsecured personal belongings (books, papers, etc.) in these cubby holes, which should be assigned and named.

To do work individually, teachers need individual carrels (25 in total) at which they can work quietly. These should be arranged as clusters of four so that individual work does not preclude collaboration. Five to six rectangular round tables should be placed around the room. The tables should have sufficient table top space so that groups of teacher can lay out their work but easy to be moved into various configurations for collaboration among more people. The rectangular shape allows the tables to be arranged to create one large meeting table for large group or departmental meetings.

The “teachers’ room” can be a single room or a series of smaller connected spaces that constitute rooms within rooms. For example, a configuration with one teacher room on every floor. Distributing teachers this way allows for easy accessibility to classrooms and students and as a smaller space it will be easier to fit it into the overall design. However, it is important to note that such an arrangement makes large group teacher interaction more difficult. Neither matters to the design team as long as they have a productive, comfortable space in which to

[23] Not all teachers will want to work in the teachers’ room. Some may wish to work in the café are; others may return to their homes after classes or go somewhere else on the campus.

work and relax. The room should have windows on exterior walls only to allow for privacy. Because of the presence of fixed laptops the room should be air conditioned. We do suggest two doors for greater ease of exit in case of an emergency.
The room should have four to five fixed computer workstations with Internet access against a wall along a computer table with at least four to five chairs so that teachers can plan activities, conduct Internet research, create worksheets and computer generated materials or correspond via email with teachers in other areas of Indonesia or the globe. There should also be productivity-related equipment, such as a copy machine, a printer, a "resource" area with paper, materials, books, and so forth. Smaller configurations of tables can provide team spaces for instructors with adjacent or contained material preparation areas and meeting space. The room should contain tack boards to post information or teacher work. There should be an area with sofas or comfortable chairs and a magazine rack so teachers can read, relax or take a nap. We also suggest the inclusion of a small kitchenette—a small refrigerator and microwave for lunch time use. Teachers most likely need a separate restroom situated near the teacher room.

The room should be in a fairly quiet section of the new facility—away from loud activity areas or common areas but not so separate that it is not easily accessible to students. The design group suggested it be located on the second floor of the new facility. Like all rooms, the teachers' room should have a lot of natural light.

Instructors would like to be able to meet with small groups of students privately, so we suggest that one end of the room have three glass enclosed areas (similar to the library) with couches and tables in each. Instructors could sign out the small rooms for an hour at a time to consult with students, hold advisement, allow students to take make up exams, etc.

The cost of furniture and equipment for the teachers' room totals $31,800. Table Ten enumerates these individual costs.

Table 10: Furniture and Equipment Costs for Teachers' Room

Types	Details	Per	Quantity	PRICE/ UNIT*	
				US $	US $
Furniture	Carrels and chairs	unit	25	200	5.000
	Sofa set	unit	2	1,500	3,000
	Table and chair set	unit	10	150	1,500
	Small sofa set (for small breakout rooms)	unit	3	1,000	3,000
	Coffee tables (breakout rooms)	unit	3	200	600
	Book cases (for resources)	unit	3	350	1,050
	Computer tables and chairs	unit	5	1,200	6,000
Total Cost Furniture				-	**$20,150**

Types	Details	Per	Quantity	PRICE/ UNIT*	
				US $	US $
Electronics	Air conditioner (2 pk)	unit	1	400	400
	Small refrigerator	unit	1	250	250
	Microwave	unit	1	250	250
	PCs (research and lesson planning)	unit	5	1,000	5,000
	Printer (HP laser jet color)	unit	1	250	250
	Mesin Foto Copy Machine	unit	1	5,500	5.500
	Total Cost Equipment			-	**$11,650**
Total Cost Furniture and Equipment					**$31,800**

H. Dean's Office

The Dean's office is designed for individual, small group and large group work. In the course of the day, the Dean does administrative and planning at his desk, meets with department chairs and small groups of visitors, and has meetings with instructors and students.

Like the teachers' room, this is a space with many fixed elements. The space should include: a large desk and chair; a book case for education-related materials; filing cabinets to store school records; a comfortable seating area with a coffee table so guests can visit and drink coffee, tea or water (as is customary) as they visit with the Dean; a clean bathroom space adjacent to the office to be used by visitors; and a round table with five to six rolling chairs for meetings (round so no one is at the "head" of the table). The space should be somewhat formal, as reflecting the status of the Dean at the FKIP, but also comfortable, so that people are able to accomplish work with the Dean and feel relaxed while visiting. This furniture does not need to be purchased; it can be moved from the Dean's office in the existing FKIP.

So he may work on FKIP-administrative issues at night, we recommend that the Dean be provided with a laptop, versus a desktop, computer with a fixed printer in the office (this can also be brought over from the existing office). Because he will typically spend all day in the office, and because the office is somewhat closed (as it is a private space, the office should have windows on the exterior walls but not on the interior walls), it should be cooled through ceiling fans or energy efficient air conditioning units. The office should be located on the ground floor, near the lobby, for easy access by students, instructors and other community members and visitors.

The Dean has four assistants, an administrative assistant, a communications person, and so on. Each assistant will need a small ante-room adjacent to the Dean's office. We do not advocate new furniture or equipment for this staff, only space. They can use their original equipment and desks from their existing offices. The spaces should be comfortable enough for one person to work productively but they should have some sort of low-cost air conditioning because of the presence of desktops. The administrative assistant's office should include enough space for a seating area for visitors.

We assume that the Dean can move his furniture and equipment to the new space and therefore have not assigned any costs for the administrative office. The only exception is $1,000 for a laptop which he may use for work purposes only at his home and office and $800 for air conditioning.

I. Community/Gallery Area

One of the goals of the new facility is to serve as a community space. For this reason the design team suggests the creation of a dedicated community or gallery area that would house art exhibits, photography exhibits, poetry readings, music, etc. This space would be located on the ground floor of the proposed FKIP facility, near the front entrance to the building, to allow for easy access for community members. Though it is possible that the space have chairs (folding chairs may be used from the current FKIP auditorium), the only furniture envisioned—other than plants to brighten up the room—are wheeled partitions on which pictures may be hung. The partitions allow for smaller configurations of spaces to be created within one room. The community/gallery area could be a separate room (a standard 9 x 8 configuration) or better still, a space created by using larger partitions to transform one large room into two smaller rooms (the community room and another classroom).

We advocate that the community/gallery room be used for classes when exhibits are not being held.

The total cost of mobile partitions will depend on the final size of the room. Mobile partitions cost $30.00 each. We assume the use of at least five for a total cost of $150.

J. Student Room

As it is important for teachers to have their own private and communal space, so too should students have a space where they can study, meet with their classmates, relax, have informal discussions, and have a central place to house various student organizations. This "student room" can be series of adjoining spaces or one space but it should be large enough to allow for possibly 50-60 students at one time. FKIP students stated that the space would benefit from having small offices which could house the various student organizations. The offices could be organized around a central common area with sofas, a coffee table, and a TV (to be supplied from the present FKIP). The spatial organization should allow for informal collaboration, group meetings and displays of student work. We also suggest transporting a couple of computers from the existing FKIP to be used in this new space. [24]

The total cost of furnishing and equipment for the student room is $4,095. Table Eleven outlines the furniture and equipment costs for the Student Room.

Table 11: Furniture and Equipment Costs for Student Room

Types	Details	Per	Quantity	PRICE/ UNIT	
				UNIT (USD)	TOTAL COST (USD)
Furniture	Sofa set	unit	5	100	500
	Tack board	unit	4	20	80
	Table and chair set (group meetings)	unit	4	500	2,000
	Small table and chair	unit	15	100	1,500
	TV stand	unit	1	15	15
Total Cost					**$4,095**

[24] There is concern about purchasing new electronic equipment (computers and TVs) for use by potentially 3500-5600 students. Student members of the design team suggested that if they were to receive new equipment they would establish an ongoing monitoring and tech support program for this equipment. This is certainly a viable option and a new PC could be dedicated to the student space. In the interim, we recommend moving a TV and PC from the existing FKIP facility to the new student space.

K. Bathrooms
There should be one bathroom for females and one for males on each of the three floors. Bathrooms must have adequate lighting, be single sex, and be easy to clean. Doors should provide full privacy; they should be able to be locked and there should be window shutters to allow for privacy. There must be receptacles in women's restrooms to accommodate sanitary product disposal, a sink and a wall mirror. Providing a handicap stall in both male and female toilets is necessary to address universal design guidelines and accommodate any handicap users of the facility.

Toilets should be stacked and located in the corners of the buildings for plumbing purposes. There should be separate toilets for teachers (one for males and one for females) near the Teacher Room and another for the administrator.

As the bathroom consists of plumbing fixtures, doors and windows, bathroom costs are included as part of construction costs.

L. Transition areas: Lobby, Corridors and Patio
Transition areas (and circulation areas, collapsed here under the rubric of "transition areas") are often neglected but are critical elements in the design of a facility as they provide for human and resource circulation, but are also spaces that form "psychological" boundaries or continuity from one type of space to another. As such they must be designed flexibly in order to meet their specific function, to provide continuity from one space to another, and to serve learner and community needs.

Due to time restrictions, the design team did not address these transition areas, so they will only be briefly noted here. Low maintenance floor finishes should be prescribed as these are mostly high traffic areas. It is also recommended that the wall finishes be like plastic emulsion paint which can be washed clean as it tends to get dirty because of frequent use.

a. Patio
See Section Six for a discussion of front patio space.

b. Corridors
Circulation patterns must encourage the integration of courses, programs and people and obviously provide for human movement from one space to another in the most efficient manner possible. The design of corridors then cannot function solely on the pathway itself and careful consideration must be given to where classrooms and specific classes will be held in order to make human transportation as efficient as possible.

The FKIP may wish to institute some sort of circulation practice (keep to the left; stairs for ascending and ramps for descending)[25] to expedite movement from one area to another.

Most likely, given the tropical climate, the corridor will be external. Corridors should be designed in such a way so that they provide continuity between inside and outside space. Where possible (given design team preferences that classrooms have windows on the exterior and interior walls), corridors should be festooned with art, photographs and plants to make the space attractive. Designers should embed fixed seating areas (stone benches), alcoves, and perhaps drinking fountains in the exterior wall space (i.e., corridor space) of the new facility to make corridors more serviceable to human needs and make for more interesting space. Notice boards can be placed in the corridors for announcements related to the university, since students use

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[25] This may be counterintuitive—especially to people who don't want to climb stairs—but it is imagined that the building, as most do, will have some sort of central staircase, toward which visitors and guests will naturally gravitate as they explore the building. Ramps, located on the side of the building, would be harder to find and might be a bit of a psychological "letdown," as they don't have the presence of stairs.

these very often this is an ideal place to spread the word about events, remedial classes, book sales etc.

Engineers estimate 1410 square meters of corridor space, or more accurately since the final building footprint size is undetermined, that corridors will comprise 25 percent of the total building area. This estimate does not include the need for a concrete ramp (separate from a staircase) to be used to transport mobile carts of laptops and mobile television equipment as well as mobility impaired users. Ramps typically consume more space than staircases and these considerations must be factored into the physical design.

c. Lobby

The lobby is often the first space visitors see when entering a new facility and the impression is often a lasting one. For that reason, special care must be paid to the design and layout of the lobby. As a transition space, it should offer elements of both adjacent interior and exterior spaces—light, plants, seating space, and an area and person welcoming those entering the new FKIP facility. The lobby should provide academic and community information, notices, news, and celebrations. If structural demands mean that the new lobby must contain the load bearing concrete columns spaced apart every ten feet or so (as in the present FKIP), then allow for the design of an adaptable interior with the use of de-mountable walls or mobile partitions between the concrete columns. This can allow exhibiting art or photos, small exhibits and small, private spaces.

As the lobby is an area of welcome, consider placing the Dean's office adjacent to the lobby, as the Dean is the official "face" of the facility.

Table 12 outlines costs for furniture for the lobby.

Table 12: Furniture Costs for Lobby

Details	Per	Quantity	Unit Cost (USD)	Total Cost (USD)
Sofa set	set	2	2,500	5,000
Display board (with glass windows)	pcs	2	200	400
Table and chair	pcs	1	150	150
Moveable partitions	set	5	150	750
Total				**$6,300**

Figure 29 provides an example of a lobby that the design team found attractive (with the exception of exposed infrastructure). The roundedness of the building, stairs and furniture give the lobby a welcoming, soft feature. There is a space dedicated to providing information, staffed by a person, and this space serves to frame the open area, along with the rounded staircase and couches on which students are visiting and relaxing. This lobby is a welcoming place, a place to linger, a place to get information—an effective transition space between the exterior and interior of the school.

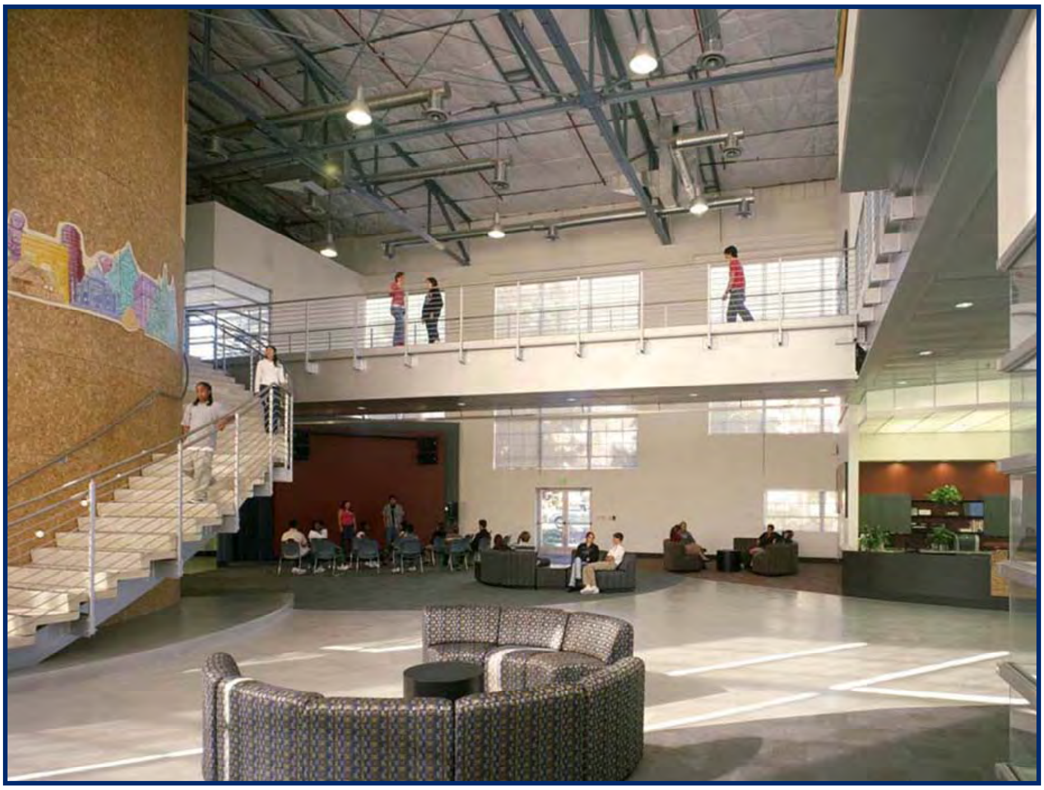

Figure 29: Design team members liked the openness and soft rounded features (stairway, the space around which it ascends, the couch and table) of this lobby area.

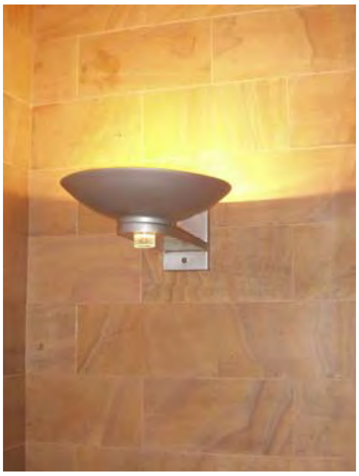

Figure 30: Example of different types of lighting fixtures. This allows for softer, background light, versus direct reading light.

M. Flooring

For all of these spaces, resilient flooring is a good choice for heavily travelled areas that need a durable surface that can be cleaned easily and that don't need the acoustic benefits of carpeting. Engineers from a nearby school facility recommended *Anzeca* (homogeneous tile) as the best floor choice. Its approximate cost is $12.00 for 30 x 30 meters. Its cost is not estimated in the budget as there is no final estimation of a building footprint size and therefore, of the total amount of flooring actually needed.

We also suggest investigating more environmentally appropriate or "green" floor type—floors that can be covered with renewable or recyclable flooring, such as rubber, bamboo, cork or linoleum.

For all kinds of flooring surfaces, walk-off mats placed at entrances and exits will absorb dirt and prevent it from getting tracked through the school. Finishes chosen should be low maintenance.

N. Lighting

Light fixtures and different types and configurations of lighting must vary according to the intended uses of a particular space. For classroom space, we recommend larger track lighting designed for large spaces (although fluorescent light is relatively inexpensive, almost ubiquitous in classrooms, and so commonly used, it remained generally unpopular among the design team for its "artificiality"). Softer, direct light should be used for reading areas within libraries and for private spaces designers may wish to investigate the use of lamps and light shading that directs light upwards (versus downwards) for a softer, decorative effect. Designers should also consider the use of energy efficient lighting (lights on timers, motion-activated lighting, and the use of energy saving bulbs).

Though we advocate the use of natural light in classrooms, the library, teachers' and students' rooms during daylight hours, classroom and library spaces will be used at night; therefore attention to lighting is critical. Public areas such as the lobby may have recessed lighting which, though more attractive, is also more expensive and involves additional costs for the required false ceiling.

O. Summary of Proposed Spaces

Table 13 provides a summary of the interior spaces listed in this section. Where possible, we provide an engineering estimate of intended space. Where engineer estimates are unknown, spaces are left blank. It must be remembered that these are initial, broad estimates of space (and money) and will change once the final building footprint size is determined.[26]

Table 13: Summary of Proposed Spaces

Type of Space	Number	Measurement	Furniture	Equipment	Total
Classroom	27	2040 m^2	$68,125	$132,350	$200,475
Library	1	1500 m^2	$19,455	$22,850	$42,305
Science lab	1	1840 m^2	$25,957	$185,505	$211,462
Prayer Room	1	60 m^2	$0	$0	$0
Teachers room	1	NA	$20,150	$11,650	$31,800
Outdoor café	1	8 x 11 m^2	$1,500	$0	$1,500
Student Room	1	NA	$4,095	$0	$4,095
Private Space	6	NA	$10,000	$0	$10,000
Lobby	1	NA	$6,300	$0	$6,300
Gallery/Community Room	1	NA	$150	$0	$150
Bathroom	6	NA	$0	$0	$0
Evaluation, Testing and Measurement Center	1	NA	$5,320	$1.800	$7,120
Administrator Office	4	NA	$0	$1.800	$1,800
Corridor	25% of space	1410 m^2	$0	$0	$0
Total	**52**	**7050** m^{2**}	**$161,052**	**$355,955**	**$517,007**

**Does not include corridor **This is the engineers' overall estimate and does not include all spaces listed in Table 11. It is provided here to give some sense of an overall estimate. It does not include outdoor café*

+ Includes the cost of all classroom technology equipment listed in Tabl8 as well as science-related materials and equipment

P. Key Considerations

A number of existing facilities, such as the kitchen and auditorium, will stay in the existing FKIP facility.

All of the information presented in this section is contingent upon two factors. First, the definitive Building Coverage Ratio (BCR) must be determined in order to determine the interior square footage of the building. Next, the issue of who (and how many) will use the library must be ascertained. If FKIP administration envisions the library as a unifying space for the entire campus, this impacts the actual physical design and the number and size of all other spaces,

[26] Many of these figures may not tally. However, they are included as they are the estimates provided by UNSYIAH engineers.

such as classrooms. The library might need to extend to part of three floors or take up an entire floor. These two issues should be resolved immediately.

Additionally, furniture and equipment costs may be minimized by using furniture from the existing FKIP facility. Potentially, the space requirements and cost of building new classrooms in the new facility can be reduced by retrofitting spaces in the existing FKIP facility (lab, administrator office, adjacent administration offices, teacher room, student room) as new classroom space. However, how much cost could be reduced is not clear. This warrants further analysis.

IX. Detailed Design Elements: Technology

Effective uses of technology and information resources require that the new facility be planned with present and future technology innovations in mind. Technology can assure greater equity of resources at the proposed facility by allowing them to be distributed to classrooms. It can also ensure greater efficiency of space—by making every room the computer room, for example, and lessening the need for specialized space (language, math and computer labs). And as computers and online connections become common within the FKIP, instructors should capitalize on technology to reach more students and teach them in different ways. But for the learning potential of technology to be achieved, FKIP instructors must dramatically alter their instructional practices. No amount of technology will compensate for poor instruction. In fact, technology may exacerbate instructional issues by diverting needed attention away from how to teach to how to use computers.

If future professional development is to focus in part on how to help instructors integrate technology to improve teaching and learning, then it makes sense to provide such technology to the FKIP. If so, proposed technology for the FKIP is listed below:[27]

- A minimum of six laptop carts (120 computers total) with DVD and CD capabilities and 40 headphones (one for each department, with the exception of primary school faculty, which is located on FKIP satellite campuses)
- Seven sets of subject specific software (science, math, English, primary school age software, etc.) to be installed on each set of laptops[28]
- Library research software (Britannica, Encarta) and access to online library
- 22 desktop computers (ten in library for virtual library access, five in library for student use (homework); five in teachers room, one in science lab, one in Testing and Measurement Center)
- Forty headsets (for use with laptops for language lab and math lab)
- One laptop for FKIP administrator (this will allow him to work at home and at the office)
- Six printers (three in library for printing researched material, one in teacher's room, one in administrator's office, one in science lab)
- One high resolution digital camera for the science departments (but to be shared on a check-out basis with all FKIP departments, as discussed in Section Eight)
- Seven ceiling mounted LCD projectors and portable screens (or wall space) for all rooms that could potentially be used as lecture spaces and science lab. One portable In-Focus projection device to be given to each department (except science since projector is mounted in lab)
- Three televisions on wheeled carts (one for every two department)
- Satellite television access
- Connect proposed and existing FKIP facility to wireless via VSAT ("hot spot" designation)
- Some fixed cabling and Ethernet connections for proposed desktops.
- Three overhead projectors

The key items will be discussed below.

[27] There is technology in the existing FKIP facility. Thus, this proposed technology will be added to what already exists and resources can be shared between the two facilities.
[28] Software for primary age students would be installed on one of the six sets of laptops to be shared by primary school instructors and students when and if they move to or visit main campus.

A. Mobility

Flexibility—of space, resources, teaching and learning— is a major design principle of the proposed facility. Laptops offer three main advantages to the new FKIP that a traditional desktop configuration would not.

First, laptops are distributive and flexible. With laptops, instructors can integrate technology into the classroom learning process; they can lead to anytime-anywhere learning (in a café, on the grounds) and they mitigate the space, cooling and security requirements necessary when installing desktops throughout the school. Laptop carts (or computers on wheels) can be securely stored in one area and "rolled out" for distribution among several classrooms, faculties, students or teachers. This way, technology is actually integrated into the learning process and is not relegated to a separate area of study, a separate class, or a separate time slot, as it is the case when there are fixed computer labs.

Second, laptops assure equity and efficiency of both resources and space. They lessen the FKIP's need for huge blocks of fixed and single-purpose space (a computer lab, English-language lab, and math lab). Four carts of laptops—80 computers— require far less in terms of storage requirements, space and utilities than a computer lab with 20 computers. Further, computer labs require dedicated space, and when computers break down, that space becomes a dead zone.

Laptops can also serve as portable labs. Headphones can reduce the need for fixed laboratory space such as that required by English-language labs and mathematics labs (both of which have been identified as priority areas by UNSYIAH administrators). The abundance of English-language material on the Internet (news services such as the BBC and *Jakarta Post,* online discussion groups, podcasts, videoblogs, audio chat) means students have more natural language opportunities than ever to hear, speak and write versus the behavioristic language instruction of so much language lab material. There is an abundance of ESL and ELL software complete with text, audio and video that can be used by students and teachers employing headsets. The same is true with math instruction. The Internet abounds with free, interactive, problem-based math web sites and math software.

Most critically, laptops result in flexible learning arrangements. Several students may work together on a laptop, particularly, as in the active learning model in which the design team was engaged, specific and accountable team roles and responsibilities are assigned to each team member. Laptops are an excellent tool for active learning because they can be removed from the classroom, where learning is often artificial, to "real world" areas where authentic learning occurs. However, laptops can only enhance student learning when supported by sound instructional practices.

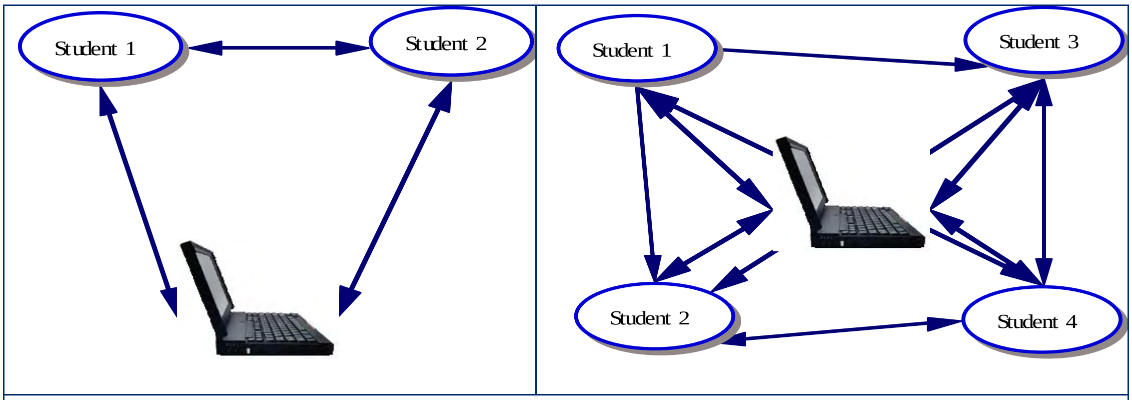

Figure 32: Shared computing provides for a variety of learning configurations. In a flexible computer arrangement, information is shared between people and computer. In an inflexible arrangement (A one-to-one ratio can often be inflexible, so too a computer lab situation) students interact with computers, not each other.

It is important here to note that laptops do pose a number of challenges. They are more expensive than desktops; have higher repair costs; and their portability makes the threat of damage, loss or theft greater. The benefits of laptops over desktops, however, far outweigh their weaknesses.

B. Wireless

Getting bandwith into schools is typically expensive. In a place like Banda Aceh, with so much rebuilding in all sectors, UNSYIAH might attempt to piggyback onto fiber optic cables in the ground being used for other purposes. However, wireless may be the better option for getting bandwith into the proposed facility (though this will depend on the availability and competitiveness of local providers). A wireless setup could free the proposed facility from having to deal with the limitations of equipment that had to be physically connected to the technology infrastructure to focus on enhancing the learning environment without the constraints that technology imposes on a site. A wireless infrastructure will also further strengthen the goal of having flexible learning spaces which get transformed to accommodate the activity and the learning/teaching styles of the users.

Configuring the proposed FKIP facility for wireless Internet access enhances the benefits of laptops. By designating the proposed (and existing) campuses as “hot spots,” students and instructors can access Internet resources and communication tools from anywhere in the building. The purchase of an online library license, for example, means that students (assigned a user name and password) could access the virtual library from their classrooms or a café area or from the laptops they bring to school from their homes (some FKIP students have laptops). Accessing such resources online would reduce the amount of space needed for a physical library.

Wireless broadband is faster than dialups or VSAT connections. It operates best at 54 -108 mps and is improving, albeit slowly. Wireless eliminates the need for extensive cabling of the new building.

Wireless does have its share of challenges. It is more expensive than traditional types of connections, such as dialup and DSL. Its transfer capacity is increasing slowly and wireless signals are susceptible to outside interference, resulting in reduced bandwith. The promise of wireless laptops used as part of improved instruction to enhance learning, however, far outweighs these challenges.

a. Future considerations-Mobile wireless
This is a little box (from companies like Kyocera, Junxion and Top Global) which, when plugged into a power outlet, provides the user and everyone within 200 feet high speed wireless Internet access. Each requires the insertion of a PC laptop card provided by a cellular carrier. The card provides the Internet connection, courtesy of those companies' 3G ("third generation") high-speed cellular data networks. The box rebroadcasts that connection as a Wi-Fi signal so that all nearby computers can go online. With these PC cards, the user can go online anywhere a cellular signal exists. In major American cities, the speed is 400 to 700 kilobytes a second. In other areas speed is only slightly faster than with a dial-up modem and uploading is far slower than downloading.

A mobile router can accommodate machines with no wireless features at all — like desktop computers — thanks to standard Ethernet network jacks on the back. And, with the frequent power outages in Banda Aceh, a mobile router can serve as a backup connection when the power goes out since it can draw its power from a car or battery pack.

C. Desktops with Ethernet Connections
“Hard” wired cables still offer faster Internet connections than wireless. This is particularly important when downloading video, for example. Though it is recommended that everything (voice, text, and video) be run over the same system, it seems to make sense (as a backup) that a smaller number of fixed Ethernet connections be employed to compensate should interference with the wireless connection occur. Special attention should be paid to the amount of wrapping of either fiber optic (cheaper) or copper (more expensive) cabling.

Networked (both LAN and WAN) desktop computers should be used in public and private spaces with multiple users, such as the teacher’s room or library. For example, approximately ten or so desktops could be placed in the library for research purposes only. They would contain access to online libraries and subscription-service virtual libraries (to which students and instructors would be assigned user names and passwords) that could be accessed from the campus, and specific CD-ROM applications, such as *Encarta*. There should be no other software contained on these machines so users cannot employ them for anything but research.

Students needing access to computers for homework, for example, could access one of five computer workstations to complete homework assignments. Five desktops and a shared printer could be placed in carrels in the teachers’ room for research, creation of materials and planning. Additionally, FKIP students have asked for one desktop and printer in a proposed student area, for use in student activities and by student organizations.

D. In-Focus Projectors
At the top of the technology “wish list” for FKIP instructors is projection devices. This immediately raises the “old wine in new skins” concern—teachers using expensive high tech equipment to deliver the same type of instruction.

Certainly there is a place for projection devices. When connected to Internet sites and online simulation sites, for example, all students can view or, through interactive pedagogy techniques, participate in an online activity. A projection device—where students see information— is a useful supplement to auditory learning (research on learning demonstrates that students retain more through audio-visual instruction than through auditory or visual instruction alone). Similarly, projectors are useful for large lecture halls. But without the proper training, the temptation may be too great for FKIP faculty to use projectors to “stand and deliver” lectures rather than facilitate the active learning process.

It is suggested then that secured ceiling-mounted projection devices be placed in certain spaces designated as lecture halls (to be operated by remote control). If partitions are employed, some of these devices could then be used for smaller classrooms. It is recommended that one projector be given to each of the six faculties for sign out by teachers. The seventh would be a ceiling-mounted projector in the new science lab. When instructors have demonstrated that they have mastered using projectors to promote active learning and other innovative teaching methodologies, if wanted, they can receive more projectors. But if they have really have moved away from lecture-based instruction, they likely won't need so many projectors.

E. Ongoing Professional Development

The FKIP should consider using technology, not just as a focus of study (computer skills classes) but also as a tool for teaching and learning, but also as a method for teacher professional development. Teachers can access the Internet to take online courses (such as EDC's *Ed Tech Leaders Online* course, Harvard University's *WIDE World* or Open University courses) to improve instruction and content knowledge. They can use educational television or satellite broadcasting programs to learn new content or improve English speaking skills. They can download compressed videos of classroom teaching episodes to better help them understand the nuances of active learning. Similarly, the FKIP, to solve its space limitation problems, may eventually want to move toward a certain percentage of its courses being offered online and offered for "open enrolment" to students in partner universities.

F. Summary of Technology Costs

Table Fifteen outlines technology costs mentioned in this section. Together, all technology costs are estimated to be $168, 000. As with all costs, these are preliminary estimates and subject to change based on the actual design of the facility.

Table 15: Technology Costs for Proposed Facility

Details	Per	Quantity	Unit Cost (USD)	Total Cost (USD)
6 trolley each 20 laptop (P4, RAM 512, HD 80 GB, DVD CDRW Combo Drive, Blue Tooth, Infra Red, Wireless, Internal Modem)	unit	120	1.000	120.000
Subject specific software (1 set for each department)	unit	7	250	1.750
Administrator laptop (P4, RAM 512, HD 80 GB, DVD CDRW Combo Drive, Blue Tooth, Infra Red, Wayer Less, Internal Modem)	unit	1	1.000	1.000
LCD Projector	unit	7	130	910
Screen	unit	3	200	600
Printer	unit	6	250	1.500
PC	unit	22	800	17.600
Overhead Projector	unit	3	300	900
Camera (Canon EOS-350D + Lens)	pcs	1	900	900
VSAT for 1 provider	set	1	5.000	5.000
Internet connection (256 Kbps for unlimited quota)	month	2 year * 12 months/year = 24 months	750	18.000
Electronic encyclopedia	unit	1	2.000	2.000
Digital Sources for library (books, journals, modules, etc)	set	1	1.000	1.000
Scanner	pcs	1	250	250
TV	set	3	250	750

Details	Per	Quantity	Unit Cost (USD)	Total Cost (USD)
Satellite TV access	license			-
Headsets	set	40	400	16.000
Total Costs				**$188.160**

G. Other Technology Considerations

The introduction of technology will spawn a number of challenges that the FKIP will need a great deal of help in handling. First, some degree of technology training will be needed for instructors. More critically they will need ongoing professional development to help them integrate technology into teaching and learning—in ways that are learner-centered and knowledge-centered. Second, without ongoing technology support (which should also focus on technology education for users), this state-of-the-art equipment and networking will fall into disrepair and obsolescence. Third, the FKIP will need to develop a technology plan and policy, conduct audits of equipment, compile information in databases, etc. Next, the FKIP will need to develop an enforceable and commonly agreed upon Acceptable Use Policy that outlines proper and improper use of technology and consequences for non compliance. Finally, administrators and staff will need to learn how to use hardware and software (especially database and spreadsheet software) for administrative purposes. Such technology capacity building for administrators should occur as part of the DBE 2 professional development.

X. Additional Considerations

During the course of the several-day design process, a number of issues emerged that were either left unresolved or not addressed. This section is designed to examine the topology of the issues that have emerged—and may emerge—from the construction of this facility. Though presented as discrete considerations they are for the most part connected as they are in fact ultimately human capacity, management and budget issues. They are presented here in order so that they can better inform the work of the DBE 2 project as it begins to address these areas in professional development with administrators and instructors, respectively.

A. Instructional Considerations

If designed as intended, the new facility will be a significant departure from the spaces with which users are familiar. In many ways, though the facility is designed to provide intended users with more resources, better equipment, and a more pleasing space, any sort of "innovative" design (the term is quite relative) demands more from the user. Consequently, faculty will need to learn how to "use" the new FKIP building. What we suggest in response to this is not a one-day orientation, but rather an ongoing, sequential orientation process (perhaps in concert with ongoing professional development offered by DBE 2).

In spite of the many opportunities and resources the new facility will provide, many in the FKIP may be unhappy with the new facility because of what it lacks: a language lab; a computer lab; a math lab; a guidance and counseling center; and separate science laboratories. The critical challenge will be psychological and instructional—getting instructors to move away from the idea of single purpose space that does their job for them (less preparation generally accompanies language lab activities than is the case with a classroom-based activity) and helping them become innovative users of whatever space they have. It will also involve helping faculty—many of whom have not previously needed to think about the logistics of instruction—to learn how to plan instructional activities in advance (e.g., signing out laptops, arranging furniture to accommodate group activities, checking out the digital camera, etc.).

A case in point is the language lab. The language lab provides "ready made" instruction for English students, typically in the form of behavioristic listen-and-reply audio language sequences. It is machine controlled and demands little of the instructor except to turn on the tape, clarify points, and assess students' comprehension. For many English-language students and instructors, the lab is the opportunity to hear and speak English.

But the new facility will not—and should not—have a language lab. Rather, instructors will be required to use laptops with headphones, English-language software and Internet resources. These multi-modal opportunities for students to use language (through writing, through video), and more "natural language" (communicating in an authentic style) opportunities, demand more creativity and innovation from the teacher who can no longer rely on the machine-controlled language instruction of a lab. Instructors will need to avail themselves of authentic English-language resources, such as news, podcasts, online radio programs, online chat, English-language pen pal exchanges, etc. Fortunately for this purpose, the Internet is largely an English-language medium. Instructors will need to provide students with access to native English speakers with all their variations in dialect and terminology (such as the many English speakers in the 200 NGOs congregated in Banda Aceh). In short, English-language instructors will have to work harder in the absence of a language lab but if they do their jobs well, greater benefits will accrue to them and to their students.

The new facility thus does not necessarily mean that instruction will be effortless. In many ways it will involve more effort as instructors will have fewer fixed elements on which to rely but also more choices of resources. Equally, the new facility does not mean that instructors will adopt new instructional practices**.** There is the real possibility that if they in fact adhere to old practices they will find that the new facility does not support their instructional style.

B. Use Considerations
In Aceh, there appears to be some hard feelings that UNSYIAH, a relatively well off institution by local standards, has received the new facility while other (presumably more deserving seems to be the logic) have not. It is critical that UNSYIAH follow through on its plans to make certain to make the facility open to its stated "partners" (IAIN and Muhammadiya's FKIPs, local area schools, as well as the primary school teacher training satellite sites).

Such a statement is not intended to cast doubt on the Rector's and Dean's good intentions. Rather the statement speaks to anticipated logistical difficulties. Presently, there is no plan, only the best of intention. How will teachers and students from Lampeneuret get to the FKIP facility? Will there be an open enrollment system so other universities can share classes at the FKIP facility? If so, to whom do fees and tuition go? If FKIP instructors are teaching students from other FKIPs, does that mean that they must teach more classes in order to reach all of their own students? Will they be remunerated for this extra course load? How does community involvement work? What are the defined responsibilities of FKIP instructors to local schools? In short, does being the recipient impose such a burden on FKIP instructors and administrators that this burden outweighs any benefit?

These are but a few of the logistical (not to mention philosophical questions) that could undermine the laudable goal of open access and collaboration. If all goes as planned, the facility will be open in Fall 2007, so it is critical that these discussions begin to take place now.

C. Utility Considerations
The addition of new technology will result in increased utility costs. For that reason it is important to attempt to offset these utility costs by minimizing the use of other utilities (air conditioning, electricity, phone, etc.) as much as possible.

Some possible suggestions are listed below:

- Invest in energy efficient conservation measures and green building techniques to minimize energy costs.
- Investigate a performance contracting system which encourages energy conservation measures. Performance guarantee is supposed to ensure annual savings because the contractor gets the contract by guaranteeing to reduce energy costs by some specific margin. If he does not do so, and a school does not achieve the guaranteed level of savings, the contractor compensates for the difference.
- As much as possible, store all technology in one place (The library is a logical choice. This centralization of storage space will cut down on the need for air conditioning costs for technology purposes.)
- Eliminate air conditioning from all spaces that do not have fixed technology but only if adequate cooling and ventilation can be achieved through intentional design, natural cooling materials and ceiling fans.
- Use motion detector lighting in classrooms so lights are only used when people enter the room.
- Put classroom lights on a timer system so that they do not come on during the day (in order to capitalize on natural light).
- Use low wattage light bulbs.
- Use green building techniques to reduce energy costs.
- Investigate the use of solar paneling.
- Use rain water harvesting as a sustainable option to reduce running costs.

The FKIP should also investigate the purchase of a generator. There is no point in having technology unless it is used and frequent power outages mean that new technologies may often be unavailable. A generator would also ensure continued access to water within the building which is necessary for purposes of hygiene, cleaning and maintenance.

Many of these utility considerations can occur in the physical design process through the use of innovative design and effective energy and sustainable building techniques that will hopefully reduce the new FKIP's utility bills.

D. Maintenance Considerations

The maintenance issue is one of the most serious facing the new facility and the theme has been woven into many areas of this report. The design and construction of the facility must take into account the FKIP's history of little or no maintenance of its current facilities.

There are some actions individuals can take to minimize the need for general maintenance. Trash barrels in hallways and in classrooms and signs reminding people not to litter could help reduce litter. Faculties or individuals might initiate some sort of variation on the "Adopt a Highway" civic program in the US where they agree to maintain a certain section of the new facility's common space. But general custodial care is not enough. Major maintenance—roof repair, plumbing, electrical monitoring and maintenance (in short all the things that if they go wrong threaten the security, health and comfort of those in the facility)—need to be overseen by professionals.

The FKIP needs to a plan for maintenance, hire a team to do maintenance, and create a budget for repairs (broken locks, roof inspections, etc.). Presently there is no maintenance plan, no money for maintenance, and no concrete ideas on what to do. The fear is that, without maintenance, the new FKIP facility could look like the old FKIP facility within a few years.

In light of these concerns about maintenance, the FKIP design team has organized itself into a steering committee, as mentioned in Section Six. They have developed some preliminary ideas to focus on maintenance issues (in fact these are custodial and light maintenance issues). The steering committee should be consulted as DBE 2 moves forward on professional development in this area.

However, in addition to management (which DBE 2 will address), maintenance is also about money and UNSYIAH doesn't have much of it for maintenance. Again, we suggest that USAID dedicate .10 percent of the cost of construction ($100,000) to create a maintenance escrow fund from which funds can be drawn to pay for maintenance, lest the new FKIP facility begin to resemble the present FKIP facility.

E. Technology Support Considerations

Increased access to and availability of technology necessitates increased technical support. Equipment must be monitored and maintained, the network fixed when it goes down, software and digital cameras inventoried, and instructors and students must receive immediate technology troubleshooting as needed. A lack of on-site and immediate technology support is often the greatest impediment to teachers using technology in their subject areas. If computers acquire the reputation as fragile and non-reliable, instructors will abandon their use. This happens all too frequently in education.

UNSYIAH and the FKIP will need to dedicate resources to creating a corps of high quality technical support staff who should, in addition to their other duties, provide some skills training and basic trouble shooting strategies to instructors. In doing so, they will build the technical capacity of FKIP instructors and thus lessen their own burden of having to fix every single problem.

There are a number of strategies the FKIP can employ to augment technical capacity support:

- Employ students as tech support staff in exchange for reduced tuition or fees. The nearby Internet cafés are largely managed by UNSYIAH students. There is no shortage of technically skilled young people who understand hardware, software, and networking issues.
- Create “tech squads” within each faculty, composed of a computer-savvy instructor and an equally savvy group of students who are responsible for addressing technical issues within the faculty. Their job can be to provide skills training and troubleshooting help to colleagues within that faculty.
- Contract with a local technical support agency to do maintenance and repair.
- Negotiate a deal with hardware, software and wireless providers to provide the FKIP with additional, free maintenance in exchange for future increased business with their company.
- Investigate partnerships with local businesses where the businesses provide free technical support in exchange for a certain amount of FKIP interns who volunteer to do work at the business (clerical work, for example).
- Collect user fees from non-UNSYIAH, IAIN and Muhammadiyah individuals for computer use and charge fees for all computer use on weekends. In effect, during the weekend, the FKIP’s fixed computers in the library, for example, might serve as an Internet café. The computer facilities may also be used by the community and the extended education community for after school programs and other community supported programs that can be charged for use of the resources. The revenue generated could be placed in a fund to be used for technical repair and maintenance.

F. Security Considerations

The presence of a new building and technology within the building will make the proposed FKIP facility more of an attractive target to thieves and vandals. The following list enumerates some broadly defined safety and security issues that should be addressed in the construction of the new FKIP facility:

- Access to building should be controlled from front entrance which should serve as the main entrance. Security personnel may need to be hired to monitor the facility during and after hours. A visitor sign-in book should be instituted to keep a record of all visitors to the facility.
- As mentioned earlier, instead of or in addition to burglar bars on windows, place hostile vegetation (thorns, etc.) against first floor-windows to discourage intruders.
- Use materials that prevent graffiti or that can be easily cleaned.
- Use large exterior grated doors at the tops of staircase in second and third floor. That way if someone enters the building in the first floor, they are confined to the first floor.
- If there is built-in roof access from the interior of building to access roof equipment, that access must be locked securely to prevent unauthorized access.
- The FKIP should invest in battery powered emergency lights or generators in the event of power loss. Similarly, it is recommended that barrels be used for rainwater catchment. This can be used in bathrooms to keep them clean and odor free. This is particularly necessary in hot climates in the event of water lock-offs.
- FKIP administration may want to invest in CCTV. However, this is expensive and requires people to monitor it and then have the authority and training to act if needed.
- As has been suggested in other sections, USAID may want to defer a small percentage of the money for the building to be used for security

XI. Costs

Though costs, where possible, have been woven in throughout the report, particularly in Section Eight, this section provides an overview of all the costs of the proposed FKIP facility by category (construction, labor, materials, furniture and equipment). While we attempted to gather all costs associated with proposed elements of the new facility mentioned in this report, many (such as the amount of material for flooring, the number of windows and doors, etc.) were not possible to gather because they are contingent upon the actual physical design or because the engineers were not familiar with them. There are also a number of items we were unable to cost (window seats, solar panels) because their use, and therefore cost, is unknown.

A total breakdown of itemized (where possible) costs is provided in Appendix One. This section of the report provides a brief description of what these cost categories represent.

Before embarking on a discussion of costs, we begin with a few caveats. First, these costs are preliminary. In many cases (construction, labor and materials) the exact methodology used to generate them is unknown. Many other costs (some furniture items, for example) are proxy costs (i.e., an estimate of that furniture item in Jakarta but not in Banda Aceh). A few technology-related costs (the cost of an online library subscription and the cost of online encyclopedias are best guesses as we have yet to receive the requested information from vendors).

Second, many of the costs come from multiple sources and may therefore conflict. Specifically, we include two sets of furniture and equipment costs—one subsumed as part of Table One (devised by UNSYIAH engineers) and a second, more itemized cost breakdown assembled by the report's authors.

Third, these costs will undoubtedly change and will be contingent upon final decisions (library usage, for example) and the exact physical design of the new facility.

Finally, the building has yet to be designed, permits have not been secured, Indonesia has a vigorous inflation rate, and construction materials in Banda Aceh are expensive and their costs rising. These considerations must govern any examination and interpretation of this information.

All costs here are given in US dollars. We use an exchange rate of $1 US=10,000 Rupiah. Attached spreadsheets provide costs in Rupiah and in dollars. Appendix tables provide costs only in US dollars.

A. Construction

Engineers' Estimates. We first present UNSYIAH engineers' estimates of the construction cost of the proposed FKIP facility.

a. Pre-Engineering and Construction

According to UNSYIAH engineers, the total cost of construction for the proposed facility is $4,597,660. This includes all pre-engineering costs (grading and filling land, securing permits), as well as material and labor for earthquake proofing, the cost of the roof and trussing, mechanical and plumbing costs, telecommunications provision (basically a phone landline), electrical work, finishing (painting and tiling). All of these costs are broken down in Table One in Appendix One.

b. Pre-Engineering, Construction and Infrastructure Provision

If landscaping, parking, and "infrastructure provision" (extending the road to the new facility, creating pathways, treating water, etc.) are added to the above set of costs, the total construction cost of the proposed facility reaches $4, 957,660.

c. Pre-Engineering, Construction, Infrastructure Provision, Furniture and Equipment
If we include engineers' estimates of furniture and equipment ($1.5 million and $3.5 million, respectively), the total cost of constructing the new facility (in addition to the landscaping, parking and infrastructure provision mentioned above) rises to $9.957.660.

d. Pre-Engineering, Construction, Infrastructure Provision, Furniture and Equipment and Design/Supervision
If all costs in Scenarios 1-3 are included, and design, supervision and management costs are integrated, the total cost of the proposed facility would be $12, 944, 958. These design, supervision and management costs are broken down as follows:

- Design Consultant Cost: $1,014,766
- Supervising Consultant Cost: $1,014,766
- Project Management: $507,383
- Construction Management: $507,383

Table Sixteen provides an overview of all of these costs. Table One in Appendix One provides a more detailed analysis of all of the construction costs. The vast majority of the costs—68 percent—are devoted to material. 32 percent of these costs are labor costs.

Table 26: Estimate of UNSYIAH Engineers' Total Costs of Construction for Proposed FKIP Facility

No	Item	Material (USD)	Labor (USD)	Total (USD)
A	General	76.000	114.000	190.000
B	Structure and Finishing	3.429.684	977.976	4.407.660
C	Landscaping and Parking	80.000	120.000	200.000
D	Supporting Facility and Infrastructure	64.000	96.000	160.000
E	Supporting Equipment	3.150.000	350.000	3.500.000
F	Supporting Furniture	1.350.000	150.000	1.500.000
G	Management, Design and Supervision	597.460	2.389.838	2.987.298
	Grand Total A-G	**$8.747.144**	**$4.197.814**	**$12.944.958**

Explanations of costs for A, B, C and D have been provided throughout the report. General costs include items such as the cost of permits. Structure and Finishing deal with the actual construction and earthquake proofing measures. Equipment includes all technology (computers, media devices and science, language lab equipment. Furniture refers to classroom and office furniture. Management, design and supervision include the cost of the physical design of the proposed facility, a facilities plan, management and supervision of the design and build phases. (Because of the rigorous seismic proofing requirements, supervision occurs at all phases—in the design process, in selection of materials and in the construction phase—to ensure that no potentially calamitous "short cuts" are being taken.)

e. Qualifications
These estimates are listed here to provide a broad estimate of costs and do not represent the final estimate for the proposed facility. They are simply one estimate to provide the reader with more data for the design-build process and these should be interpreted with a number of qualifications in mind.

First, these costs are generated from an estimate of the last building constructed at UNSYIAH (in 2004 before the tsunami). They are not generated from any particular facilities or site plan as those documents were destroyed in a fire.[29]

Second, the reader must bear in mind a number of considerations in interpreting these costs.

- Based on conversations with local engineers at a nearby school in Sigli, there is some concern that these construction costs may be too low given the high inflation rate, relatively high labor costs and scarcity of construction materials in post-tsunami Aceh province.
- These costs do not include the provision of so-called green features or green building techniques.
- They do not include the actual construction of interior facilities such as the multi-purpose lab nor do they include the cost of design features advocated by the Design Team, such as windows on the interior and exterior of classrooms, a ramp, varied lighting fixtures (recessed, etc.), the use of partitions to create flexible classroom space, the use of large shutters on east-facing windows, security measures, such as grilled windows and doors for the library, the creation of an arched gate at the front of the proposed facility, and other design features such as semi-impermeable cover or caliche for parking.

Third, equipment costs in Table Sixteen are based on the design of three separate science labs as well as a language lab, most of which is not relevant. As will be recalled from Sections Six, Seven, and Eight, the Design Team advocated the creation of one multi-purpose science lab and no language lab.

Fourth, cost items such as the cost of permits are most likely underestimated as they do not take into consideration two actions that the Design Team has advocated—moving parking to the back of the building or to an off-site location and the modification of the external design of the structure (to a contemporary Acehnese design)—both of which may involve seeking variances (an additional cost.)

Fifth, if there is concern that construction costs are too low, there is similar concern that the design, management and supervision estimates are too high. Generally, these costs should not exceed ten percent of the cost of construction.[30] (See the corresponding footnote for more information about design fees.)

Once again, the numbers presented here are an estimate, based on data available at the time of the writing of this report. Designers will obviously need to conduct their own cost investigations.

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[29] Email communication: Dr. Arussalim, March 2006: *The visual facility plan and all engineering drawing of UNSYIAH's existing facility are not available. Those were archived at Majid Ibrahim Building Center, that got fire four years ago, all those documents were destroyed, and no data were leftover.*

[30] There appear to be two sorts of bids for architectural design— *International Competitive Bid* (ICB) and *Local Competitive Bid* (LCB). The fee of over $1,000,000, according to UNSYIAH engineers, is based on the *International Competitive Bid* (ICB) maximum design fee of approximately ten percent of total construction costs. These include structural analysis for earthquake buildings, all production of engineering drawing and details, books of all explanation of specifications of architectural, structural, mechanical, electrical, plumbing, etc and all tender documents. For comparison, LCB (*Local Competitive Bid*) design fee is about 5% of total construction costs. Engineers state that for all support fee of design, supervision and management fee are 15-30% of total construction costs of ICB and 8-15% of LCB.

f. Conclusion
Given the fact that we (EDC) have provided itemized costs of furniture and equipment and given the fact that USAID will hire its own design, management, and supervision team as part of the design-build process, it makes sense to use the second cost scenario *(*Pre-Engineering, Construction and Infrastructure Provision*)* of $4.957.660 as a realistic estimate for construction costs. This leaves an extra $5.1 million (roughly) to cover non-costed construction items such as green building features, light fixtures, provision of doors and windows, construction of interior spaces (such as science lab and prayer room), adding acoustic decking and noise abatement features, the creation of a ramp, floors, creation of in-built features such as book cases and storage cabinets (as much as possible these should be built into the structure of the building as opposed to being free standing furniture), the use of partitions for flexible space, the cost of placing security bars on windows and a grilled door for the library, installing shutters and the cost of architect, engineer and contractor fees.

B. Furniture
The total cost of furniture for the proposed facility is estimated at $161,052. Furniture costs are listed below:

- Classroom $68,125
- Science Lab $25,957
- Teachers Room $20,150
- Library $19,455
- Private Spaces $10,000
- Evaluation, Testing and Measurement Center $5, 320
- Lobby $6300
- Students Room $4095
- Outdoor Café $1500
- Gallery/Community Room $150
- Musholla $0
- Administrator Office $0

Section Two of Appendix One provides detailed tables outlining furniture costs. The report does not have a separate section listing furniture costs. All furniture costs are organized by the proposed space. Section Two of the Appendix breaks furniture costs out in this manner.

Figure 33 illustrates the breakdown of furniture costs by proposed areas. As can be seen, 44 percent of furniture costs are assigned to classrooms, 17 percent for the science lab, 13 percent for the teachers’ room and 12 percent for the library. The remaining 14 percent is distributed over the remaining seven spaces.

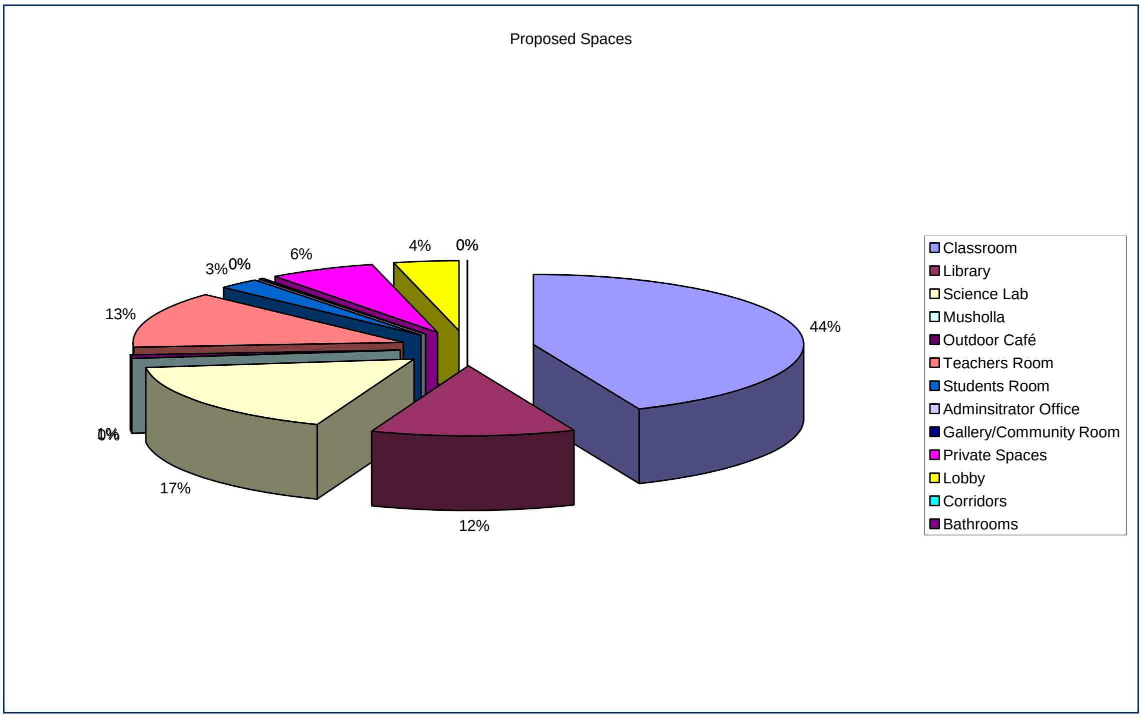

Figure 33: Percentage of Furniture Costs by Proposed Spaces

The largest expense for furniture is for 202 classroom tables (seating four students) and 810 chairs (27 classrooms x 30 students per room)[31] totaling $60,700 ($20,200 and $40,500, respectively). This $60,700 represents 38 percent of total furniture costs. This is followed by $25, 957 for furniture requirements for the proposed multipurpose lab, representing 16 percent of furniture costs. Together, student desks (tables), chairs and lab furniture account for 55 percent of the cost of total furniture.

Figure 34: Common classroom furniture arrangement in existing FKIP facility.

Furniture costs may be reduced by moving furniture from the existing facility to the new facility. However, as the goal is to promote an environment that facilitates collaborative, learner-centered instruction. Current student furniture prototypes (see Figure 34) are not conducive to this type of learning.

C. Equipment (Technology and Science Equipment and Materials)

Within this report, "equipment" falls into three broad categories. The first is all technology items (hardware, software and connectivity). The second is specific biology, chemistry and physics related equipment for the proposed multipurpose science lab. The third is miscellaneous equipment costs such as microwaves, refrigerators, air conditioning (as air conditioning will be assigned to certain spaces as a cost cutting measure), etc.

The total cost for all equipment, including technology, and all science equipment and materials is $361,977. 50.

[31] This is a general estimate. Recall that in Section Eight, engineers call for 20 classrooms to house 30 students and seven accommodating 60 students.

Of this amount, $185,504.50 is for science equipment (tools, glassware, materials, electronics etc.) —$84,669 is for physics equipment and materials and $98,906.00 for chemistry and biology materials. A completely itemized account of all chemistry, physics and biology materials can be founded in Tables Twelve and Thirteen in the Appendix.

Science costs were estimated by UNSYIAH FKIP science teachers (physics costs were winnowed to some degree by EDC science specialists[32]). The costs for science could most likely be winnowed farther but it was difficult to find science experts to perform such a task within such a compressed time period.

D. Technology

The total cost for technology is $173,973. Seventy-two percent (approximately $140,000 of the total amount) is for hardware (121 laptops and 22 desktops). Eighteen thousand dollars is for Internet connectivity.

Technology costs may be somewhat low. For example, departments could probably benefit from more than $250.00 in software per department.

E. Other Equipment

Other equipment costs primarily include refrigerators, a microwave, air conditioning (as the Design Team advocates that it be available only in areas with standing desktops, we have factored it out as a separate cost). This amount is small, approximately $2,500.

F. Miscellaneous/Unassigned Costs

There are a number of items that were unable to be estimated because engineers were not familiar with them, because costing is contingent upon the final physical design of the new facility or because we could not find actual costs.

Some of these items are listed in Table Seventeen. This table collapses miscellaneous equipment and material costs (such as fire extinguishers, for example) with "unassigned" costs (such as windows and floor covering). Though the total given is approximately $28,903, this amount is severely underestimated. The figures are provided simply to provide designers with an idea of additional materials and equipment.

Table 17: Miscellaneous and Unassigned Costs

Details	Per	Quantity	Unit Cost (USD)	Total Cost (USD)
Shutters	meter	1	22000	22.000
Partitions	meter	2.2 meters high. Price increases with height (450000)	300 or 450	NA
Generator	pcs	1	125.000	1.650
Anzeca floor cover	meter	30 x 30 m.	120000	
Carpet	meter	10 m * 12 m = 120	8	960
Trash barrel	pcs	18	5	90
Fire extinguisher	pcs	6	55	330
First aid kit	set	7	50	350

[32] June Foster and Marian Pasquale, Center for Science Education, Education Development Center.

Details	Per	Quantity	Unit Cost (USD)	Total Cost (USD)
Skylight	set	1	2.000	2.000
Solar panel	unit	1	350	350
Iron grills (windows)	set	2	100	200
Grilled outer door (library)	set	2	299	598
Carts	unit	5	25	125
Acoustic reinforced/double wall windows	unit			NA
Doors	unit			NA
Cleaning supplies	set	5	50	250
Total				**$28,903**

G. Total Costs for Proposed FKIP Facility

The amount of costs we have been able to gather for the proposed FKIP facility total approximately $6.9 million. Of this $6.5 million is for construction, furniture, and design and management fees. Approximately $362,000 is estimated for all technology and equipment costs and almost $29,000 is assigned for miscellaneous costs. The costs we have been able to gather thus far are outlined in Table Eighteen.

Table 18: Current List of Costs for Proposed FKIP Facility

No	Type	Total Cost
A1	Construction	$4.957.660,00
A2	Furniture	$161.052,10
A3	Design, Management Fees	$1.480.000,00
A	**Sub Total: Construction and Furniture**	**$6.598.712,10**
B1	Equipment (Technology)	$173.973,00
B2	Equipment (Science Equipment)	$185.504,50
B3	Equipment (Miscellaneous)	$2.500,00
B	**Sub Total: Equipment and Other Technology**	**$361.977,50**
C	Miscellaneous/Unassigned Costs	$28.903,00
A+B+C	**Total Costs**	**$6.989.592,60**

Figure 34 illustrates the proportional breakdown of these costs. The remainder of this section explains them.

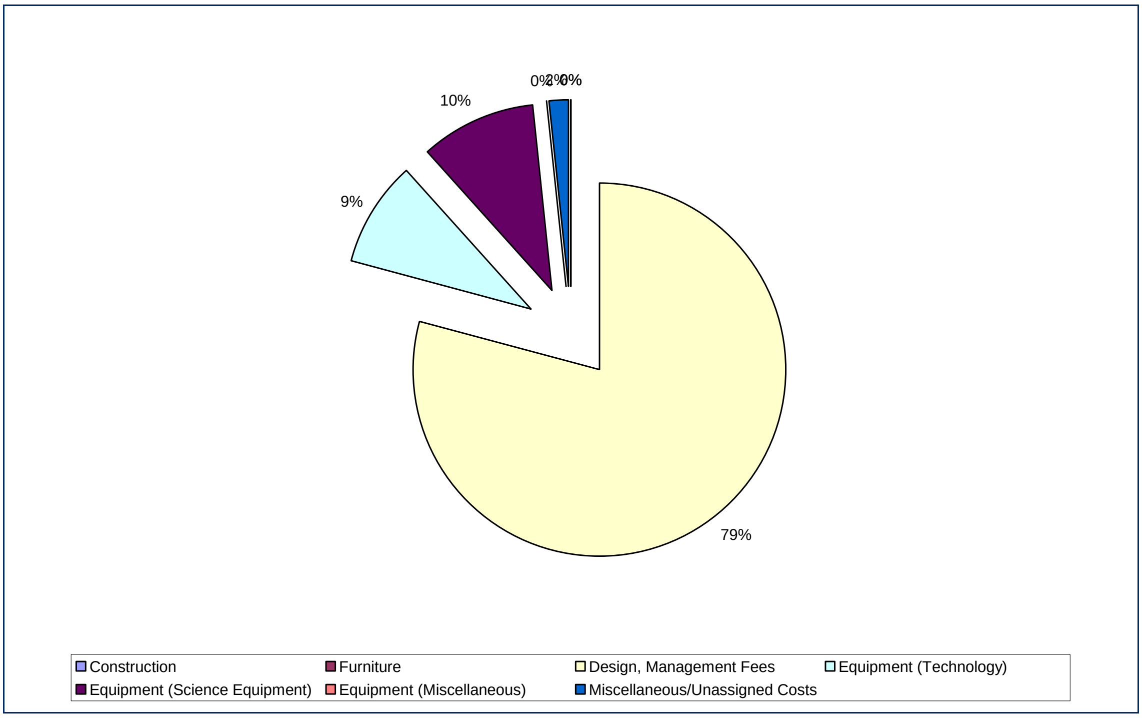

Figure 34: Breakdown of All Costs Associated with Proposed FKIP Facility

a. Construction (Part A)

The $4.9 million for construction is based on UNSYIAH engineers' estimates of all pre-engineering, construction, landscaping and infrastructure costs. These costs are outlined in Table One of the Appendix.

Furniture costs are itemized by EDC on a room-by-room basis for the new facility. They are frugal estimates as we believe that the new facility can use some of the existing furniture in the existing facility.

Design and management fees are derived by EDC, using the UNSYIAH architects' formula of ten percent for design fees, ten percent for supervision, five percent for construction and five percent for project management. However, our fees are lower than UNSYIAH engineers' fees ($1.48 million versus $2.9 million) because they are based on the cost of construction alone (not on the total cost of the facility which in the UNSYIAH estimate included an additional $5 million for furniture and equipment.). Fees will vary according to the type of bidding standard used. We present these simply as a guideline to be considered in the overall cost of the facility.

The figure of $6.9 million dollars is not the amount of money necessary to build the new facility—it is simply the amount we were able to estimate at this time. As has been pointed out throughout this report, there are gaps in the estimates available because engineers were not able to provide costs because they were unfamiliar with certain techniques or items (for example, green building techniques, solar paneling, the use of shutters, double walled windows, recessed lighting, etc.) or because the final physical design has yet to be created (thus, they were unable to provide measurements and costs for doors, windows, the amount of flooring and carpeting).

Ten million dollars has been assigned to the cost of building and furnishing the proposed FKIP facility. The $3.1 million that remains will need to be dedicated toward the inclusion of (among other items) green features and energy conservation measures, fixtures such as doors, lighting, windows, and floor covering, at the very least. It can be easily imagined that these items alone will assume most of the remaining money. For example, if UNSYIAH engineers' estimate of architect fees is correct, the cost of the facility for construction, furniture and fees alone will total $8.1 million.

Of the remaining unassigned funds in the $10 million, it is recommended that these funds be used first for green building techniques and energy conservation measures (to help reduce recurrent maintenance and utility costs in the new facility). The difference (the money that remains) should next be used to retrofit the existing FKIP facility in order to help the two facilities achieve some sort of physical parity.

b. Equipment (Part B)
These costs were the most painstakingly assembled and in putting together equipment costs we attempted to be quite frugal. Nonetheless, we are aware that in being so painstaking we may have underestimated some costs. For example, part of the plan for the UNSYIAH facility is that it have access to an online library database. As of yet, we have been unable to ascertain prices for Indonesian or English-language library databases and as a placeholder have listed the price as $2,000. The $362,000 or so here is well below the $2 million that may be available for equipment and material costs. Costs for technology and equipment have been itemized based on 2006 costs for these items but do not include the cost of shipping or handling these items.

We have also kept costs down by limiting access to technology in the proposed facility. Designers will obviously conduct a more thorough cost analysis in the design and procurement phases so these numbers may change. If there is any additional money for equipment and technology, we suggest that it be used first to purchase more library books for the new facility and then that it be used to provide some technology (and technical support) to the existing FKIP facility to diminish the disparity in resources between the existing and proposed facility.

c. Unassigned Costs (Part C)
This is the largest unknown in the universe of proposed FKIP facility costs and these costs can easily change the funding calculus for the new facility. The majority of costs in this category are contingent upon design, and as we have mentioned throughout the report, though engineers have offered some measurements for the new facility, these numbers are contingent upon building and planning regulations that have not yet been determined. Therefore engineers were not able to provide us with costs for windows, doors, light fixtures, floor materials, etc.

Three factors will significantly impact the real cost of the proposed facility: regulations (what is and is not permissible in terms of building design, size and footprint and adjacent land use); the availability of materials and labor in post-tsunami and reconstruction-intensive Aceh province; and the use of green building techniques, which, if they can be used given regulations and the strictures of design given all the earthquake regulations should add to the construction cost of the proposed facility.

d. Conclusion
We have a general idea on the cost of the facility and material and equipment. These costs are based on the best available data between February 24 and March 8, 2006. They are neither exhaustive nor conclusive and may be very different in another few months. Those carrying this project forward will obviously need to conduct their own cost research.

XII. Next Steps

Following the completion of the conceptual, or pre-design, phase of the UNSYIAH FKIP facility, the next phase is the actual physical design phase which will be undertaken by the assigned architects, engineers, and builders. Among other actions, they will conduct a site analysis, create a physical design of the new facility based on descriptions here, begin costing the construction of the facility, and build it. There are four steps USAID can undertake now to help expedite the physical design and construction process.

First, consider hiring an Indonesian lawyer who specializes in land use law. It is important, particularly for a facility with such visibility, that all land use regulations, building codes, zoning, BCR, and all other regulations be investigated, verified, documented, and observed, particularly if there are multiple agencies (university, city and province) with separate, multiple or even overlapping regulatory authority. Presently, there are some existing issues that could delay the actual design and construction (BCR of 30 percent or 40 percent, need for parking, etc.). It is best to get these issues resolved, especially if they involve applying for variances, so they do not delay the physical design and actual construction. It is not advisable to look to engineers or other NGOs for definitive information on land use and building codes. It is best to hire a lawyer who knows the actual law.

Second, given what appears to be an accelerated schedule, investigate the use of a design-build approach where, instead of a traditional approach of hiring an engineer to design the facility and contractors to create the facility, a single entity is responsible for the design and construction of the facility. With this approach, from the beginning, those involved in designing the facility (architects, engineers, consultants, etc.) would be working together with those who will build it.

Third, within the bidding process, assure the use of well-documented, accurate and a complete set of drawings and specifications to result in competitive bids with lower costs. Contractors are able to figure their costs more accurately, eliminating the need to pad their bids to assure themselves of adequate contingencies.[33]

Fourth, hold discussions with UNSYIAH administration about the FKIP library. The primary user group must be ascertained (is the library intended for FKIP students, all UNSYIAH students or the entire Banda Aceh community) as this will determine the size of the intended library (and consequently the amount of available space for classrooms). Because of incompatible schedules, the rector and conceptual design consultant were unable to discuss this issue. The conflicting information about who the library is primarily designed to serve should be resolved before the actual physical design phase begins.

[33] This may appear so obvious as to not warrant mention. However, the bidding process for projects with such tight timelines often results in incomplete or missing documents. Political pressures demand haste. Architects produce incomplete construction documents because they do not allow or are unwilling to request enough time. Architects promise impossible schedules in order to be selected. And construction managers and design/builders put unrealistic expectations on architects regarding the time needed to produce accurate drawings and specifications.

XIII. Recommendations

In moving forward with the physical design phase, the following actions are recommended:

1. The possibility of retrofitting the existing FKIP facility for classroom space should be examined and researched. At present, there is no estimate of the actual cost of doing so (though it should be less costly to retrofit than to build a structure).[34] The FKIP could conceivably solve its classroom space issues by building a new facility and retrofitting the existing facility.
2. Before commencing the next phase of this process, architects and engineers should review, and where necessary, revise the plans and report submitted here as costs will rise or fall, information will become more complete and university or project priorities may change. The design team would also need to do a thorough site analysis and cost analysis to guide their design proposal.
3. Involve the design team, particularly the steering committee, in the next phases of the project. They have the will, the interest and the on-site expertise, and should continue to be as involved in the physical design phase as they were in the conceptual design phase.
4. The steering committees should be vested with full authority by the rector and deans to propose and implement innovative policies regarding the proposed facility, particularly in the areas of maintenance, security, and landscaping.
5. Because of the lack of familiarity with "green building techniques" and energy conservation measures, coupled with the need to reduce recurrent building expenses, use performance contracting within the request for proposal phase so that energy savings from utility expense reductions can pay for maintenance, for example, over many years.[35]
6. In the next phases of this project, the designated architects must work to educate their clients (the new facility users of FKIP). This experience has shown that it is not enough to ask potential users "what they want," because they may not know. By working in a similar iterative, participatory manner with FKIP faculty and students to gather their comments and suggestions, solicit their feedback in the design process, and educate them about the actual design-build and engineering process, the design-build phase of this project can serve to build the capacity and knowledge of UNSYIAH FKIP instructors.
7. Once the new facility is opened, involve an architect, engineers, technology specialists and instructional professional development providers to orient FKIP faculty and students in how spaces are designed to function best, how to use the technology at their disposal and for ongoing support in innovative instructional practices.
8. Consult with UNSYIAH engineers and architects in the design and construction of the creation of the new FKIP facility. As with the participatory conceptual design process, participatory planning in the physical phase should create a sense of ownership, pride and accountability on the part of UNSYIAH engineers and should result in greater linkages between the Faculty of Engineering and FKIP. More practically, it makes sense to involve the expertise of those who know existing campus facilities best.
9. During the physical design phase, architects should have ongoing discussions with EDC staff in order to create a physical space that best promotes learning and that is aligned with the desired goals of the design group.

[34] A general rule of thumb is that renovation is about 65 percent of the cost of construction. However, this cost must be investigated.

[35] Within performance contracting, utility savings are realized through various energy conservation measures (ECM) that may include high-efficiency lighting retrofits; computer-controlled energy management; and the replacement and redesign of older, inefficient ventilating and air-conditioning equipment and systems. A performance guarantee should ensure annual savings because if a school does not achieve the guaranteed level of savings, the contractor compensates for the difference.

10. In the design-build phase, architects and engineers should work with the UNSYIAH administration to create a construction mitigation plan that identifies specific tasks (e.g., noise mitigation, dust emissions, access issues, etc) and creates a schedule to address and mitigate these issues.
11. DBE 2 should begin in earnest a strong program of general in-service, instruction or assistance for UNSYIAH administrators, particularly the FKIP Dean. Several issues need to be addressed regarding the creation and sustainability of this new FKIP facility. These include:
    - *Policy support for the new facility and its use.* This should include how the new facility will be shared with neighboring primary and secondary schools and partner university FKIPs (IAIN and Muhammadiyah). It can range also from the creation of Acceptable Use Policies for computer and network use to "behavioral" issues (shoes on or off in certain rooms, opening and closing times of special rooms, and issues of food and drink around computers).
    - *Technical support* for computers. Making sure hardware, software and connectivity are maintained and educating faculty in troubleshooting technical issues in order to build their expertise and skills with technology.
    - *Maintenance* of the new facilities themselves and the upkeep of all infrastructure.
    - *Managerial* issues. Budgeting, supervision of staff, etc.
    - *Program organization.* Programming space efficiently and equitably, equitable distribution of instructional responsibilities, and ensuring that classes are capped at an optimal teaching load (30), to name but a few issues.
12. Facilities management is a critical issue that must be pursued further with FKIP faculty and administration during the architectural design process. This is where the steering committee's participation will be invaluable. (They have proposed such ideas as utility savings realized through various energy conservation measures; the possibility of creating "work study"—deferred or defrayed fees for students who maintain the new facility, etc.). UNSYIAH will need additional help and resources in this area.
13. The FKIP, indeed UNSYIAH, could benefit by adopting a program that helps them manage their cleaning and maintenance operations. This might involve knowing the right cleaning regimen for the various interior finishes found in the new facility, training workers properly so they are aware of the latest equipment and safety steps, and creating a schedule that allows workers to clean buildings most effectively with the least disruption to classroom instruction. Once again, USAID should consider deferring a small percentage of the cost of construction and placing it in an escrow account to be used to help pay for repairs and maintenance in the new facility over a period of several years.
14. The conceptual phase and participatory design process was an excellent opportunity for FKIP instructors to learn about educational facilities planning. The next phase (design-build) could be even more so. USAID and DBE 2 personnel should push and assist the FKIP in designing and offering a course on facilities design for learning. This would make the UNSYIAH FKIP unique among Indonesian teacher training programs.
15. Monitor actual use: once the design has been completed and the building constructed, the facility may not be used as intended — original planning concepts have been ignored because of changes in the school board, administration or staff. Administrators should make sure all are committed to the educational philosophy, organizational concepts and delivery methodology. This monitoring might include facilities "benchmarking" in which benchmarks (space use, for example) are established, quantified and measured.
16. Consider converting some fixed facilities (computer labs, science labs and library) or duplicating such facilities to mobile facilities. Mobile libraries, computer labs (perhaps using mobile wireless connections or VSAT) and science laboratories could get FKIP resources directly to the schools and partner universities in need of such supports.

APPENDIX A

APPENDIX A

FKIP Cost Summaries

Section 1: Construction Costs

Table One: Estimate of Unsyiah Engineers' Costs for Proposed FKIP Facility
All Construction, Materials, Furniture, Equipment and Design Costs

PRELIMINARY ESTIMATION OF TOTAL COST PER WORK ITEMS							
No	**Type of Work**	**Sq. M**	**Unit**	**Component Portion**	**Compensation Factor**	**Unit Price in USD**	**Total Cost in USD**
A	**GENERAL**						
1	**Preparation & Temporary Works**						
	(Preparation & Temporary works, Permission costs)		Ls				120.000
2	**Grading and Elevation**						
	(Cut & fill, soil analysis and improvement, etc.)		Ls				70.000
	Total: Pre-Engineering						**190.000**
B	**STRUCTURE AND FINISHING**						
1	**Cost of Earthquake Proofing**						
1,1	**Material cost**	7050	m2	0,44	1,2	600	2.233.440
1,2	**Labor cost**	7050	m2	0,11	1	600	465.300
	Total: Material and Labor (Earthquake Proofing)						**2.698.740**
2	**Truss and Roof**						
2,1	**Material cost**	3760	m2	0,105	1,2	600	284.256
2,2	**Labor cost**	3760	m2	0,045	1,2	600	121.824
	Total: Material and Labor (Roof and Trussing)						**406.080**
3	**Mechanical & Plumbing**						
3,1	**Material cost**	7050	m2	0,028	1,2	600	142.128
3,2	**Labor cost**	7050	m2	0,012	1,2	600	60.912
	Total: Material and Labor (Mechanical & Plumbing)						**203.040**
4	**Electrical**						
4,1	**Material cost**	7050		0,028	1	600	118.440
4,2	**Labor cost**	7050		0,012	1	600	50.760
	Total: Material and Labor (Electrical)						**169.200**
5	**Telecommunication**						
5,1	**Material cost**	7050		0,014	1	600	59.220
5,2	**Labor cost**	7050		0,006	1	600	25.380
	Total: Material and Labor (Telecommunication)						**84.600**

6	**Finishing** *(Plastering, painting, tiling, etc.)*					
6,1	**Material cost**	7050	0,14	1	600	592.200
6,2	**Labor cost**	7050	0,06	1	600	253.800
	Total: Material and Labor (Finishing)					**846.000**
	Sub Total All Structure and Finishing					**4.597.660**
	OTHER COSTS					
C	**Landscaping and Parking**	ls				**200.000**
D	**Supporting Facility & Infrastructure** *(inner road and pedestrian, ground water treatment, drainage and water supply system, etc.)*	ls				**160.000**
E	**Equipment***	ls				**3.500.000**
F	**Supporting Furniture***	ls				**1.500.000**
	Total: Other Costs (C, D, E, F)					**5.360.000**
	Sub Total of (A+B+C+D+E+F)					**9.957.660**
G	**Management, Design & Supervising****					
1.1	Design Consultant Cost	ls				**995.766**
1.2	Supervising Consultant Cost	ls				**995.766**
1.3	Project Management	ls				**497.883**
1.4	Construction Management	ls				**497.883**
	Total: All Management, Design and Supervision (G)					**2.987.298**
	Total: All Costs (A, B, C, D, E, F)					**12.944.958**

** These costs have been included to provide a general idea of engineers' estimates. Furniture and equipment costs have been eliminated from the final tally.*
*** Management, design and supervision costs are as a rule 10 percent of total construction costs*

Table Two:
Summary of Material and Labor Costs
Construction of Proposed FKIP Facility

No	Item	Material (USD)	Labor (USD)	Total (USD)
A	General	76.000	114.000	190.000
B	Structure and Finishing	3.429.684	977.976	4.407.660
C	Landscaping and Parking	80.000	120.000	200.000
D	Supporting Facility and Infrastructure	64.000	96.000	160.000
E	Supporting Equipment	3.150.000	350.000	3.500.000
F	Supporting Furniture	1.350.000	150.000	1.500.000
G	Management, Design and Supervision	597.460	2.389.838	2.987.298
	Grand Total A-G	**$8.747.144**	**$4.197.814**	**$12.944.958**

Section 2: Interior Spaces

This section summarizes all Interior Space costs outlined in Section Eight of the report.

Table One:
Cost of Classroom Furniture and Equipment

Types	Details	Per	Unit Cost US $	Total Cost US $
FURNITURE	Instructor table	unit	50	1350
	Student's desk*	unit	100	20200
	Lecturer's chair	unit	50	1350
	Student's chair**	unit	50	40500
	White board	unit	100	2700
	Trash barrels	unit	5	135
	Display board	unit	35	1890
Total Furniture				**$68125**
ELECTRONIC	6 trolleys— 20 laptops each (120 laptops) (P4, RAM 512, HD 80 GB, DVD CDRW Combo Drive, Blue Tooth, Infra Red, Wireless, Internal Modem)	unit	1000	120000
	Subject specific software (1 set for each department)	unit	250	1750
	LCD Projector (NEC VT47)	unit	1300	9100
	Screen	unit	200	1400
	Overhead Projector	unit	300	2100
Total Equipment				**134350**
Total Furniture and Equipment				**$202475**

*Amounts based on 30 students x 27 classrooms *30/4 x 27 classrooms=202 tables * *30 x 27 classrooms = 810 chairs*

Table Two:
Cost of Science Lab Furniture

Detail	Unit	Amount	Unit Price (USD)	Total Cost (USD)
Students' station	pcs	5	620	3.100
Wall bench	pcs	2	1.161	2.322
Preparation table	pcs	2	1.450	2.900
Chemical storage	pcs	3	535	1.605
Storage cabinet	pcs	4	320	1.280
Laminar flow	pcs	2	3.600	7.200
Fume hood	pcs	1	4.496	4.496
Fish Tank	pcs	2	500	1.000
Ticket window	pcs	2	400	800
Sink basin	pcs	4	75	300
Buret sink / deep sink	pcs	1	15	15
Peg board / draining rack	pcs	2	300	600
Stool	pcs	25	10	250
Softboard	pcs	6	15	90
Total				**$25.957**

Table Three:
Cost of Science Lab Equipment

Detail	Unit	Amount	Unit Price (USD)	Total Cost (USD)
Personal Computer[1]	set	1	800	800
Camera (Canon EOS-350D + Lens)	pcs	1	900	900
Printer	pcs	1	250	250
Air Conditioner	pcs	2	650	1.300
Exhaust fan	pcs	4	20	80
Refrigerator (2 doors)	pcs	1	350	350
Water purifier (or water dispenser, hot and cool; for drinking station)	pcs	2	100	200
Total		**12**		**$3.880**

[1] Intel P4 3.2 GHz, HDD 80 GB Sata, RAM 1 GB Visipro, VGA 128 MB, LAN, Sound Card, Chassing 2 USB Front, Motherboard P 915 GL,DVD Combo, Floppy Drive, Monitor LCD 15"

Table Four:
Cost of Furniture and Equipment for Library

Types	Items	Per	Quantity	PRICE/ UNIT* Unit Cost (USD)	Total Cost (USD)
FURNITURE	Book rack	unit	10	350	3.500
	Books	set	1	2.000	2.000
	Shelf	unit	5	400	2.000
	Conference table	unit	3	150	450
	Sofa set	unit	5	1.500	7.500
	Chairs (librarian, assistant and tech support person)	unit	3	100	300
	Desks (librarian, assistant and tech support person)	unit	3	200	600
	Small table and chairs (pair or small group study)	unit	10	100	1.000
	Computer tables and chairs	unit	5	120	600
	Display board	unit	3	35	105
	Locker 30 doors	unit	2	700	1.400
	Total Costs				**$19.455**
ELECTRONIC	PCs (research and typing)	unit	15	800	12.000
	Research software (Encyclopedia Britannica, Encarta)	license	1	2.000	2.000
	Printer (HP laser jet)	unit	2	250	500
	Scanner	unit	1	250	250
	Air conditioner	unit	2	400	800
	Headset	unit	40	25	1.000
	TV	unit	3	250	750
	Cart (TV)	unit	1	50	50
	Mesin Photo Copy Machine	unit	1	5.500	5.500
	Total Equipment				**$22.850**
Total Cost Furniture and Equipment					**$42,305**

Table Five:
Cost of Furniture for "Private" Spaces

Details	Per	Quantity	PRICES: UNIT/TOTAL	
			Unit Cost (USD)	Total Cost (USD)
Sofa set	unit	5	1.500	7,500
Display board	unit	2	200	400
Table	unit	4	500	2.000
Chair	unit	4	25	100
Total Costs				**$ 10,000**

Table Six:
Cost of Furniture and Equipment for Teachers' Room

Types	Details	Per	Quantity	PRICE/ UNIT*	
				US $	US $
Furniture	Carrels and chairs	unit	25	200	5.000
	Sofa set	unit	2	1.500	3.000
	Table and chair set	unit	10	150	1.500
	Small sofa set (for small breakout rooms)	unit	3	1.000	3.000
	Coffee tables (breakout rooms)	unit	3	200	600
	Book cases (for resources)	unit	3	350	1.050
	Computer tables and chairs	unit	5	1.200	6.000
Total Cost Furniture				-	**$20.150**
Electronics	Air conditioner (2 pk)	unit	1	400	400
	Small refrigerator	unit	1	250	250
	Microwave	unit	1	250	250
	PCs (research and lesson planning)	unit	5	1.000	5.000
	Printer (HP laser jet color)	unit	1	250	250
	Mesin Photo Copy Machine	unit	1	5.500	5.500

Types	Details	Per	Quantity	PRICE/ UNIT*	
				US $	US $
Total Cost Equipment				-	**$11.650**
Total Cost Furniture and Equipment					**$31.800**

Table Seven:
Cost of Furniture and Equipment for Evaluation Testing and Measurement Center

Types	Items	Per	Quantity	PRICE/ UNIT	
				UNIT COST (USD)	TOTAL COST (USD)
FURNITURE	Book rack	unit	5	350	1750
	Shelf	unit	5	400	2.000
	Conference table	unit	1	150	150
	Sofa set	unit	1	1.000	1.000
	Small table and chairs (pair or small group study)	unit	3	100	300
	Computer tables and chairs (1 table, 4 chairs)	unit	1	120	120
	Total Cost Furniture				**$5320**
EQUIPME NT	PCs (research)	unit	1	800	800
	Subscription: Evaluation and testing journals, newsletters	unit	1	500	500
	Printer (HP laser jet)	unit	2	250	500
	Total Cost Equipment				**$1800**
Total Cost Furniture and Equipment					**$7,120**

Table Eight:
Cost of Furniture and Equipment for Student Room

Types	Details	Per	Quantity	PRICE/ UNIT	
				UNIT (USD)	TOTAL COST (USD)
FURNITURE	Sofa set	unit	5	100	500
	Tack board	unit	4	20	80
	Table and chair set (group meetings)	unit	4	500	2.000
	Small table and chair	unit	15	100	1.500
	TV stand	unit	1	15	15
Total					**$4,095**

Table Nine:
Cost of Furniture for Lobby

Details	Per	Quantity	Unit Cost (USD)	Total Cost (USD)
Sofa set	set	2	2.500	5000
Display board (with glass windows)	pcs	2	200	400
Table and chair	pcs	1	150	150
Moveable partitions	set	5	150	750
Total				**$6300**

Table Ten:
Summary Costs of Furniture and Equipment for Other Spaces

Types	Items	Per	Quantity	PRICE/ UNIT	
				UNIT COST (USD)	TOTAL COST (USD)
	Dean's Office: Laptop	unit	1	1000	1000
	Dean's office: Air Conditioning	pcs	2	400	800
	Gallery/Common Area: Moveable Partitions	pcs	5	30	150
	Café: Umbrella covered tables and chairs	pcs	10	150	1500
	Total				**$3450**

Table Eleven:
All Furniture and Equipment Costs (All Spaces)

Type of Space	Number	Measurement	Furniture	Equipment	Total
Classroom	27	2040 m^2	$68.125	$132.350	$200.475
Library	1	1500 m^2	$19.455	$22.850	$42.305
Science lab	1	1840 m^2	$25.957	$185.505	$211.462
Musholla	1	60 m^2	$0	$0	$0
Teachers room	1	NA	$20.150	$11.650	$31.800
Outdoor café	1	8 x 11 m^2	$1.500	$0	$1.500
Student Room	1	NA	$4.095	$0	$4.095
Private Space	6	NA	$10.000	$0	$10.000
Lobby	1	NA	$6.300	$0	$6.300
Gallery/Community Room	1	NA	$150	$0	$150
Bathroom	6	NA	$0	$0	$0
Evaluation, Testing and Measurement Center	1	NA	$5.320	$1.800	$7.120
Administrator Office	4	NA	$0	$1.800	$1.800
Corridor	25% of space	1410 m^2	$0	$0	$0
Total	**52**	**7050** m^{2**}	**$161.052**	**$355.955**	**$517.007**

Table Twelve: Biology and Chemistry Equipment and Materials

1. Safety Equipment

No.	Detail	Qty.	Unit	Estimated price/unit		Total Price	
				Rp	$	Rp	$
1	Fire extinguisher, 3 kg	2	pcs	Rp 553.200	55,32	Rp 1.106.400	110,6
2	Fire blanket	1	pcs	Rp 825.000	82,50	Rp 825.000	82,5
4	Fire and chemical resistant bin	1	pcs	Rp 565.000	56,50	Rp 565.000	56,5
6	Hazardous symbol sticker	2	set	Rp 5.000	0,50	Rp 10.000	1,0
7	First aid kit	1	box	Rp 150.000	15,00	Rp 150.000	15,0
TOTAL SAFETY EQUIPMENT						***Rp 2.656.400***	***$ 265,60***

2. Supporting Tools and Equipments

No.	Detail	Qty.	Unit	Estimated price/unit		Price	
				Rp	$	Rp	$
1	Room thermometer-barometer-hygrometer	2	pcs	Rp 50.000	5,00	Rp 100.000	$ 10,00
3	Tray, h = 20 cm	60	pcs	Rp 10.000	1,00	Rp 600.000	$ 60,00
4	Tray, h = 5 cm	60	pcs	Rp 10.000	1,00	Rp 600.000	$ 60,00
TOTAL SUPPORTING TOOLS & EQUIPMENT						***Rp 1.300.000***	***$ 130,00***

3. SPECIFIC LAB ELECTRONICS

No.	*Name*	*Qty*	*Per*	*Unit Price*		*Total Cost*	
				Rp.	*US*	*Rp.*	*US*
1	Air pump	1	unit	Rp 10.300.000	$ 1.030	Rp 10.300.000	$ 1.030
2	Analytic balance digital, 0.001g	1	unit	Rp 29.400.000	$ 2.940	Rp 29.400.000	$ 2.940
3	Ashing oven (furnace)	1	pcs	Rp 14.000.000	$ 1.400	Rp 14.000.000	$ 1.400
4	Auto clave	1	pcs	Rp 25.000.000	$ 2.500	Rp 25.000.000	$ 2.500
5	Conductivity meter	2	pcs	Rp 7.500.000	$ 750	Rp 15.000.000	$ 1.500
6	Digital balance, 0.01 g	2	pcs	Rp 3.500.000	$ 350	Rp 7.000.000	$ 700
7	Digital pH meter	2	pcs	Rp 3.000.000	$ 300	Rp 6.000.000	$ 600
8	Dissolved oxygen meter	1	pcs	Rp 1.770.000	$ 177	Rp 1.770.000	$ 177
9	Distilled water installation	1	set	Rp 7.500.000	$ 750	Rp 7.500.000	$ 750

Table Twelve: Biology and Chemistry Equipment and Materials

10	Freezer	1	pcs	Rp	50.000.000	$	5.000	Rp	50.000.000	$	5.000
11	Heating mantel	2	pcs	Rp	1.700.000	$	170	Rp	3.400.000	$	340
12	Incubator	1	pcs	Rp	3.600.000	$	360	Rp	3.600.000	$	360
13	Magnetic stirrer and hot plate	4	pcs	Rp	5.000.000	$	500	Rp	20.000.000	$	2.000
14	Oven, dry	1	pcs	Rp	4.660.000	$	466	Rp	4.660.000	$	466
15	Power supply 5A, 60 Watt	7	pcs	Rp	840.000	$	84	Rp	5.880.000	$	588
16	Rotary evaporator vacuum	1	pcs	Rp	20.124.000	$	2.012	Rp	20.124.000	$	2.012
17	Shaker	1	pcs	Rp	10.000.000	$	1.000	Rp	10.000.000	$	1.000
18	Thermostatic centrifuge	1	pcs	Rp	8.760.000	$	876	Rp	8.760.000	$	876
19	Thermostatic water bath shaker	1	pcs	Rp	18.500.000	$	1.850	Rp	18.500.000	$	1.850
20	UV lamp	2	pcs	Rp	150.000	$	15	Rp	300.000	$	30
21	UV/Vies Spectrophotometer	1	pcs	Rp	30.000.000	$	3.000	Rp	30.000.000	$	3.000
22	Water pump, small size	5	pcs	Rp	300.000	$	30	Rp	1.500.000	$	150
TOTAL SPECIFIC ELECTRONICS								***Rp***	***292.694.000***	***$***	***29.269***

4. OTHER LAB APPARATUS

No.	***Name***	***Spec***	***Qty***	***Per***	***Unit Price***		***Total Cost***	
					Rp.	***US***	***Rp.***	***US***
1	Altimeter		1	unit	Rp 11.700.000	$ 1.170	Rp 11.700.000	1.170,00
2	Anaerobic jar		1	unit	Rp 25.000.000	$ 2.500	Rp 25.000.000	2.500,00
3	Anemometer		1	unit	Rp 6.230.000	$ 623	Rp 6.230.000	623,00
4	Auxanometer		1	unit	Rp 5.500.000	$ 550	Rp 5.500.000	550,00
5	Balance Triple Bearn	375 AA 116	4	piece	Rp 2.000.000	$ 200	Rp 8.000.000	800,00
7	Battery holder		7	pcs	Rp 7.500	$ 1	Rp 52.500	5,25
9	Beaker, polypropylene (nalgin) 500 ml		6	pcs	Rp 11.000	$ 1	Rp 66.000	6,60
10	Blood test kit		3	pcs	Rp 85.000	$ 9	Rp 255.000	

Table Twelve: Biology and Chemistry Equipment and Materials

											25,50
11	Boss head		35	pcs	Rp	26.700	$	3	Rp	934.500	93,45
12	Clamp for 2 burette		15	pcs	Rp	348.000	$	35	Rp	5.220.000	522,00
13	Clamp, ring		5	pcs	Rp	154.000	$	15	Rp	770.000	77,00
14	Clamp, universal		30	pcs	Rp	230.000	$	23	Rp	6.900.000	690,00
16	Counter		5	pcs	Rp	55.000	$	6	Rp	275.000	27,50
17	Deep net		2	pcs	Rp	4.000.000	$	400	Rp	8.000.000	800,00
18	Dissecting pan		8	pcs	Rp	73.500	$	7	Rp	588.000	58,80
19	Dissecting set college	308AA521	20	set	Rp	300.000	$	30	Rp	6.000.000	600,00
20	Dissecting set vertebrae	308A551	20	set	Rp	325.000	$	33	Rp	6.500.000	650,00
21	Electrodes (carbon)		30	pair	Rp	3.000	$	0	Rp	90.000	9,00
22	Eychkman grab		2	pcs	Rp	7.410.000	$	741	Rp	14.820.000	1.482,00
23	Eyepiece Micrometer/ Eyepiece graticule	MM-978-979	35	pcs	Rp	35.000	$	4	Rp	1.225.000	122,50
24	Field thermometer		5	pcs	Rp	50.000	$	5	Rp	250.000	25,00
25	Forceps (12 cm)		20	pcs	Rp	60.000	$	6	Rp	1.200.000	120,00
27	Genetic box (5 colors)		6	set	Rp	216.000	$	22	Rp	1.296.000	129,60
28	Germination chamber		1	pcs	Rp	60.000.000	$	6.000	Rp	60.000.000	6.000,00
29	Haemocytometer		5	pcs	Rp	750.000	$	75	Rp	3.750.000	

Table Twelve: Biology and Chemistry Equipment and Materials

								375,00
30	Hagameter		2	pcs	Rp 4.500.000	$ 450	Rp 9.000.000	900,00
31	Hb - Meter Ao Spencer	335A81	5	pcs	Rp 875.000	$ 88	Rp 4.375.000	437,50
33	Hygrometer mason		3	pcs	Rp 75.000	$ 8	Rp 225.000	22,50
34	Inoculating loop		10	box	Rp 75.000	$ 8	Rp 750.000	75,00
35	Inoculating wire		20	pcs	Rp 10.000	$ 1	Rp 200.000	20,00
36	Insect net		8	pcs	Rp 26.800	$ 3	Rp 214.400	21,44
37	Insectariums		3	pcs	Rp 72.500	$ 7	Rp 217.500	21,75
38	Kymograph set + paper		2	pcs	Rp 4.000.000	$ 400	Rp 8.000.000	800,00
39	Light bulb holder		7	pcs	Rp 20.000	$ 2	Rp 140.000	14,00
42	Micropipette 1 µl - 5 µl		1	pcs	Rp 3.310.000	$ 331	Rp 3.310.000	331,00
43	Micropipette 10 µl - 100 µl		1	pcs	Rp 3.520.000	$ 352	Rp 3.520.000	352,00
44	Micropipette 100 µl - 1 µl		1	pcs	Rp 3.550.000	$ 355	Rp 3.550.000	355,00
45	Micropipette 5 µL - 10 µL		1	pcs	Rp 3.310.000	$ 331	Rp 3.310.000	331,00
46	Microscope kit		4	set	Rp 135.000	$ 14	Rp 540.000	54,00
47	Microscope, binocular		31	pcs	Rp 3.500.000	$ 350	Rp 108.500.000	10.850,00
48	Microscope, binocular stereo		1	unit	Rp 12.700.000	$ 1.270	Rp 12.700.000	1.270,00
49	Microscope, fluorescent		1	pcs	Rp 50.000.000	$ 5.000	Rp 50.000.000	

Table Twelve: Biology and Chemistry Equipment and Materials

								5.000,00
50	Microscope, triniculer + video		1	pcs	Rp 70.000.000	$ 7.000	Rp 70.000.000	7.000,00
51	Microtome, sliding		2	pcs	Rp 150.000	$ 15	Rp 300.000	30,00
53	Osmosis kit		8	pcs	Rp 500.000	$ 50	Rp 4.000.000	400,00
54	Photometer	YUH-180 X	1	pcs	Rp 7.500.000	$ 750	Rp 7.500.000	750,00
55	Plankton net No.12		1	pcs	Rp 3.000.000	$ 300	Rp 3.000.000	300,00
56	Plankton net No.20		1	pcs	Rp 4.500.000	$ 450	Rp 4.500.000	450,00
57	Quadrat		6	pcs	Rp 75.000	$ 8	Rp 450.000	45,00
58	Respiration apparatus		6	pcs	Rp 200.000	$ 20	Rp 1.200.000	120,00
59	Respirometer, Ganong		20	pcs	Rp 225.000	$ 23	Rp 4.500.000	450,00
60	Rubber bulb pipette filler		30	pcs	Rp 80.000	$ 8	Rp 2.400.000	240,00
61	Rubber cap for Erlenmeyer		10	pcs	Rp 22.500	$ 2	Rp 225.000	22,50
62	Sample box		2	pcs	Rp 120.000	$ 12	Rp 240.000	24,00
63	Secchi disk		1	pcs	Rp 700.000	$ 70	Rp 700.000	70,00
64	Simple respirometer		20	pcs	Rp 250.000	$ 25	Rp 5.000.000	500,00
65	Soil capillarity apparatus		1	pcs	Rp 350.000	$ 35	Rp 350.000	35,00
66	Soil tester		1	pcs	Rp 2.300.000	$ 230	Rp 2.300.000	230,00
69	Sphygmanometer		5	pcs	Rp 200.000	$ 20	Rp 1.000.000	

Table Twelve: Biology and Chemistry Equipment and Materials

								100,00
70	Spiritus burner (stainless steel)		30	pcs	Rp 20.000	$ 2	Rp 600.000	60,00
71	Staining tube		10	pcs	Rp 55.000	$ 6	Rp 550.000	55,00
72	Statif		35	pcs	Rp 30.500	$ 3	Rp 1.067.500	106,75
73	Sterilizing box for Petri dish		1	pcs	Rp 700.000	$ 70	Rp 700.000	70,00
74	Sterilizing box for pipette		1	pcs	Rp 640.000	$ 64	Rp 640.000	64,00
75	Stethoscope		5	pcs	Rp 63.000	$ 6	Rp 315.000	31,50
76	Stirrer bar		5	pcs	Rp 20.000	$ 2	Rp 100.000	10,00
77	Stop watch, digital		7	pcs	Rp 200.000	$ 20	Rp 1.400.000	140,00
78	Terrarium		1	pcs	Rp 150.000	$ 15	Rp 150.000	15,00
81	Test tube holder		35	pcs	Rp 3.000	$ 0	Rp 105.000	10,50
82	Test tube rack		20	pcs	Rp 15.000	$ 2	Rp 300.000	30,00
83	Thermometer rack holder		2	pcs	Rp 15.000	$ 2	Rp 30.000	3,00
84	Tongs, stainless steel, 250 mm		32	pcs	Rp 105.000	$ 11	Rp 3.360.000	336,00
85	Triangles for crucible		10	pcs	Rp 10.000	$ 1	Rp 100.000	10,00
86	Tripod, iron		35	pcs	Rp 70.000	$ 7	Rp 2.450.000	245,00
87	Vaskulum		5	pcs	Rp 76.500	$ 8	Rp 382.500	38,25
88	Voltmeter AC/DC		7	pcs	Rp 8.522	$ 1	Rp 59.655	

Table Twelve: Biology and Chemistry Equipment and Materials

											5,97
89	Washing bottle polypropylene (anti leaking)		35	pcs	Rp	35.000	$	4	Rp	1.225.000	122,50
90	Water sampler LaMotte		1	pcs	Rp	5.060.000	$	506	Rp	5.060.000	506,00
93	Worm box		1	pcs	Rp	75.000	$	8	Rp	75.000	7,50
TOTAL LAB APPARATUS									***Rp***	***509.508.555***	***50.950,86***

5. GLASSWARE

No.	***Name***	***Qty***	***Per***	***Unit Price***		***Total Cost***	
				Rp.	***US***	***Rp.***	***US***
1	Beaker glass 100 ml (Pyrex)	35	pcs	11.200	1,12	392.000	39,20
2	Beaker glass 1000 ml (Pyrex)	6	pcs	20.000	2,00	120.000	12,00
3	Beaker glass 250 ml (Pyrex)	60	pcs	12.100	1,21	726.000	72,60
4	Beaker glass 600 ml (Pyrex)	6	pcs	17.100	1,71	102.600	10,26
5	Boiling tube (Pyrex)	30	pcs	15.000	1,50	450.000	45,00
6	Buchner funnel, 75 ml	5	piece	300.000	30,00	1.500.000	150,00
7	Burette 50 x 0.1 ml (Pyrex)	35	pcs	1.335.800	133,58	46.753.000	4.675,30
8	Burette 10 x 0.1 ml (Pyrex)	5	pcs	1.050.000	105,00	5.250.000	525,00
9	Burette brush	5	pcs	5.000	0,50	25.000	2,50
10	Calorimeter	10	pcs	50.000	5,00	500.000	50,00
11	Capillary pipes "J"	10	pcs	13.500	1,35	135.000	13,50
12	Chromatography column 320 mm	5	pcs	42.000	4,20	210.000	21,00
13	Condenser, liebeg (Pyrex)	6	pcs	85.000	8,50	510.000	51,00
14	Conductivity cell	7	pcs	65.000	6,50	455.000	45,50
15	Cover glass	10	pcs	750.000	75,00	7.500.000	750,00
16	Crocodile clip	30	pcs	2.500	0,25	75.000	7,50
17	Desiccators glass, knob top 10 L	2	piece	4.500.000	450,00	9.000.000	900,00
18	Dropping bottle 100 ml, clear	30	pcs	5.000	0,50	150.000	15,00
19	Dropping Pipette, thick glass & thick rubber, 100pcs/pack	1	pack	75.000	7,50	75.000	7,50

Table Twelve: Biology and Chemistry Equipment and Materials

20	Dropping plate	30	pcs	26.700	2,67	801.000	80,10
21	Erlenmeyer 100 ml (Pyrex)	30	piece	60.000	6,00	1.800.000	180,00
22	Erlenmeyer 250 ml (Pyrex)	30	piece	75.000	7,50	2.250.000	225,00
23	Erlenmeyer 500 ml (Pyrex)	5	piece	100.000	10,00	500.000	50,00
24	Erlenmeyer 1000 ml (Pyrex)	5	piece	125.000	12,50	625.000	62,50
25	Erlenmeyer, with side pipe	6	pcs	25.000	2,50	150.000	15,00
26	Evaporating basin, with spout (50 mL)	15	pcs	63.000	6,30	945.000	94,50
27	Evaporating basin, with spout (170 mL)	15	pcs	140.000	14,00	2.100.000	210,00
28	Evaporating basin, with spout (100 mL)	10	pcs	105.000	10,50	1.050.000	105,00
29	Filtering funnel	35	pcs	20.000	2,00	700.000	70,00
30	Fractionating column 370 mm (Pyrex)	5	pcs	150.000	15,00	750.000	75,00
31	Gauze, stainless steel	35	pcs	17.200	1,72	602.000	60,20
32	Graduated pipette 1 ml (Pyrex)	6	pcs	26.000	2,60	156.000	15,60
33	Graduated pipette 10 ml (Pyrex)	30	pcs	35.000	3,50	1.050.000	105,00
34	Graduated pipette 25 ml (Pyrex)	10	pcs	60.000	6,00	600.000	60,00
35	Graduated pipette 50 ml (Pyrex)	3	pcs	60.000	6,00	180.000	18,00
36	Kuvet	2	packs	741.600	74,16	1.483.200	148,32
37	Measuring cylinder 5 ml (Pyrex)	5	pcs	50.000	5,00	250.000	25,00
38	Measuring cylinder 10 ml (Pyrex)	10	pcs	50.000	5,00	500.000	50,00
39	Measuring cylinder 100 ml (Pyrex)	10	pcs	50.000	5,00	500.000	50,00
40	Measuring cylinder 50 ml (Pyrex)	30	pcs	50.000	5,00	1.500.000	150,00
41	Measuring cylinder 500 ml (Pyrex)	2	pcs	100.000	10,00	200.000	20,00
42	Measuring cylinder 1000 ml (Pyrex)	2	pcs	100.000	10,00	200.000	20,00
43	Micro culture object glass	2	pack	150.000	15,00	300.000	30,00
44	Mortar & pestle (160 mm)	15	set	13.600	1,36	204.000	20,40
45	Mortar & pestle (50 mm)	15	set	13.600	1,36	204.000	20,40
46	Mortar & pestle (80 mm)	15	set	13.600	1,36	204.000	20,40

Table Twelve: Biology and Chemistry Equipment and Materials

47	Mortar porcelain	5	pcs	150.000	15,00	750.000	75,00
48	Object glass	20	pcs	125.000	12,50	2.500.000	250,00
49	Petri dish	100	piece	25.000	2,50	2.500.000	250,00
50	Crucible porcelain, glazed 25 mL + lid	15	pcs	44.000	4,40	660.000	66,00
51	Crucible porcelain, glazed 50 mL + lid	15	pcs	50.000	5,00	750.000	75,00
52	Reagan bottle 1000 ml, amber	10	pcs	37.700	3,77	377.000	37,70
53	Reagan bottle 1000 ml, clear	2	pcs	33.500	3,35	67.000	6,70
54	Reagan bottle 1000 ml, polyethylene	2	pcs	45.750	4,58	91.500	9,15
55	Reagan bottle 250 ml, amber	60	pcs	16.100	1,61	966.000	96,60
56	Reagan bottle 250 ml, clear	20	pcs	14.250	1,43	285.000	28,50
57	Reagan bottle 250 ml, polypropylene	10	pcs	17.250	1,73	172.500	17,25
58	Reagan bottle 500 ml, amber	30	pcs	30.000	3,00	900.000	90,00
59	Round flask, for distillation, 100 ml (Pyrex)	5	pcs	100.000	10,00	500.000	50,00
60	Round flask, for distillation, 600 ml (Pyrex)	5	pcs	125.000	12,50	625.000	62,50
61	Sample tube	5	pcs	10.000	1,00	50.000	5,00
62	Separating funnel + cap (Pyrex)	5	pcs	250.000	25,00	1.250.000	125,00
63	Soxhlet extractor	1	pcs	400.000	40,00	400.000	40,00
65	Stopcock	2	pcs	216.600	21,66	433.200	43,32
66	Test plate	10	piece	85.000	8,50	850.000	85,00
67	Test tube, 18 (d) x 150 mm	60	pcs	5.000	0,50	300.000	30,00
68	Test tube, 18 (d) x 150 mm (Pyrex)	35	pcs	8.000	0,80	280.000	28,00
69	Test tube, d = 13 mm	30	pcs	3.000	0,30	90.000	9,00
70	Thermometer -10 - 100 C alcohol	20	pcs	20.000	2,00	400.000	40,00
71	Thermometer -5 - 50 C alcohol	10	pcs	20.000	2,00	200.000	20,00
72	U tube	6	pcs	65.000	6,50	390.000	39,00

Table Twelve: Biology and Chemistry Equipment and Materials

73	Volumetric flask 100 ml (Pyrex)	35	pcs	35.000	3,50	1.225.000	122,50
74	Volumetric flask 1000 ml (Pyrex)	5	pcs	75.000	7,50	375.000	37,50
75	Volumetric flask 250 ml (Pyrex)	15	pcs	45.000	4,50	675.000	67,50
76	Volumetric flask 50 ml (Pyrex)	15	pcs	35.000	3,50	525.000	52,50
77	Volumetric flask 10 ml (Pyrex)	5	pcs	35.000	3,50	175.000	17,50
78	Volumetric flask 5 ml (Pyrex)	5	pcs	35.000	3,50	175.000	17,50
79	Volumetric pipette 2 ml (Pyrex)	5	pcs	15.500	1,55	77.500	7,75
80	Volumetric pipette 5 ml (Pyrex)	5	pcs	15.500	1,55	77.500	7,75
81	Volumetric pipette 10 ml (Pyrex)	35	pcs	20.000	2,00	700.000	70,00
82	Volumetric pipette 25 ml (Pyrex)	5	pcs	25.000	2,50	125.000	12,50
83	Volumetric pipette 50 ml (Pyrex)	5	pcs	25.000	2,50	125.000	12,50
84	Watch glass, d = 150 mm	15	pcs	7.600	0,76	114.000	11,40
85	Watch glass, d = 80 mm	15	pcs	6.350	0,64	95.250	9,53
86	Weighing bottle	25	piece	50.000	5,00	1.250.000	125,00
87	Y tube (Pyrex)	6	pcs	14.000	1,40	84.000	8,40
	TOTAL GLASSWARE					***115.318.250***	***11.531,83***

6. DISPLAY

No.	***Name***	***Qty***	***Per***	***Unit Cost***		***Total Cost***	
				Rp.	***US***	***Rp.***	***US***
1	Amoeba (utuh)	1	pcs	25.000	2,50	25.000	2,50
2	biology 1	1	set	150.000	15,00	150.000	15,00
3	biology 2	1	set	300.000	30,00	300.000	30,00
4	cacing kerongkongan p.b	1	pcs	25.000	2,50	25.000	2,50
5	cartilago	1	pcs	25.000	2,50	25.000	2,50
6	coccus bacteria	1	pcs	25.000	2,50	25.000	2,50
7	corn leaf	1	pcs	25.000	2,50	25.000	2,50
8	corn root	1	pcs	25.000	2,50	25.000	2,50
9	corn stem	1	pcs	25.000	2,50	25.000	2,50
10	dicotyle root	1	pcs	25.000	2,50	25.000	2,50
11	dicotyle stem	1	pcs	25.000	2,50	25.000	2,50

Table Twelve: Biology and Chemistry Equipment and Materials

12	dry preparat (5 items)	1	set	125.000	12,50	125.000	12,50
13	Ephitelium	1	pcs	50.000	5,00	50.000	5,00
14	ficus muscle t.s	1	pcs	25.000	2,50	25.000	2,50
15	ficus, leaf	1	pcs	25.000	2,50	25.000	2,50
16	heart muscle	1	pcs	25.000	2,50	25.000	2,50
17	human blood	1	pcs	25.000	2,50	25.000	2,50
18	hydra whole mounted	1	pcs	25.000	2,50	25.000	2,50
19	involuntary muscle p.l	1	pcs	25.000	2,50	25.000	2,50
20	Lilium	1	pcs	100.000	10,00	100.000	10,00
21	lilium, leaf p.l	1	pcs	25.000	2,50	25.000	2,50
22	mammalia histology	1	pcs	350.000	35,00	350.000	35,00
23	mammalian intestenum	1	pcs	25.000	2,50	25.000	2,50
24	mammalian skin	1	pcs	25.000	2,50	25.000	2,50
25	monocotyledon root	1	pcs	25.000	2,50	25.000	2,50
26	monocotyledon stem	1	pcs	25.000	2,50	25.000	2,50
27	onion root	1	pcs	25.000	2,50	25.000	2,50
28	osteogenesis p.l	1	pcs	25.000	2,50	25.000	2,50
29	otot rambut manusia	1	pcs	25.000	2,50	25.000	2,50
30	Pumpkin stem p.b	1	pcs	25.000	2,50	25.000	2,50
31	Pumpkin stem p.l	1	pcs	25.000	2,50	25.000	2,50
32	salmonella bacteria	1	pcs	25.000	2,50	25.000	2,50
33	steriated muscle/otot lurik p.l	1	pcs	25.000	2,50	25.000	2,50
34	sun flower, old root	1	pcs	25.000	2,50	25.000	2,50
35	sun flower, young root	1	pcs	25.000	2,50	25.000	2,50
36	Vermes	1	pcs	25.000	2,50	25.000	2,50
35 mm Slide					0,00	0	0,00
1	Bacteria	1	set	120.000	12,00	120.000	12,00
2	Life cycle	1	set	50.000	5,00	50.000	5,00
3	Blood cell	1	set	80.000	8,00	80.000	8,00
4	Human history	1	set	50.000	5,00	50.000	5,00

Table Twelve: Biology and Chemistry Equipment and Materials

5	Biology	1	set	130.000	13,00	130.000	13,00
TOTAL						***2.255.000***	***225,50***

7.2. MODELS

No.	***Name***	***Qty***	***Per***	***Unit Cost***		***Total Cost***	
				Rp.	***US***	***Rp.***	***US***
1	Brain	1	set	143.500	14,35	143.500	14,35
2	Cell to embryo	1	set	142.200	14,22	142.200	14,22
2	Cow	1	set	309.900	30,99	309.900	30,99
3	DNA Helix	1	set	200.000	20,00	200.000	20,00
3	Ear	1	set	144.500	14,45	144.500	14,45
4	Embryo development	1	set	422.400	42,24	422.400	42,24
4	Eye	1	set	142.200	14,22	142.200	14,22
5	Flower - parts	1	set	142.400	14,24	142.400	14,24
5	Gastric	1	set	137.900	13,79	137.900	13,79
6	Heart	1	set	146.200	14,62	146.200	14,62
6	Hip, man's	1	set	139.800	13,98	139.800	13,98
7	Hip, woman's	1	set	137.600	13,76	137.600	13,76
7	Human's Skeleton	1	set	476.300	47,63	476.300	47,63
8	Kidney	1	set	110.400	11,04	110.400	11,04
8	Lung	1	set	134.400	13,44	134.400	13,44
9	Meiosis	1	set	145.000	14,50	145.000	14,50
9	Mitosis	1	set	145.000	14,50	145.000	14,50
10	Molecule	1	set	160.000	16,00	160.000	16,00
10	Skin	1	set	145.000	14,50	145.000	14,50
11	Tongue	1	set	135.500	13,55	135.500	13,55
11	Torso	1	set	290.700	29,07	290.700	29,07
TOTAL						***3.950.900***	***395,09***

7.3. CHARTS

No.	***Name***	***Qty***	***Per***	***Unit Cost***		***Total Cost***	
				Rp.	***US***	***Rp.***	***US***

Table Twelve: Biology and Chemistry Equipment and Materials

No.	Name	Qty	Per	Unit Cost	Total Cost	Unit Cost	Total Cost
				Rp.	US	Rp.	US
1	Safety standard	1	sheet	99.500	9,95	99.500	9,95
2	Annelida	1	sheet	45.000	4,50	45.000	4,50
3	Arthropoda	1	sheet	45.000	4,50	45.000	4,50
4	Ascaris cycle	1	sheet	45.000	4,50	45.000	4,50
5	Bacteria's	1	sheet	45.000	4,50	45.000	4,50
6	Blood transportation in amphibia	1	sheet	45.000	4,50	45.000	4,50
7	Bryophtya cycle	1	sheet	45.000	4,50	45.000	4,50
8	Coordination organ system	1	sheet	45.000	4,50	45.000	4,50
9	Digestion organ	1	sheet	45.000	4,50	45.000	4,50
10	epistasi/Hipostasi & polimery	1	sheet	45.000	4,50	45.000	4,50
11	Generative plant dev.	1	sheet	45.000	4,50	45.000	4,50
12	Human history	1	sheet	45.000	4,50	45.000	4,50
13	Human blood circulation system	1	sheet	45.000	4,50	45.000	4,50
14	Human coordination system	1	sheet	45.000	4,50	45.000	4,50
15	Human digestion system	1	sheet	45.000	4,50	45.000	4,50
16	Human excretion	1	sheet	45.000	4,50	45.000	4,50
17	Human muscle	1	sheet	45.000	4,50	45.000	4,50
18	Human nervous system	1	sheet	45.000	4,50	45.000	4,50
19	Human respiration system	1	sheet	45.000	4,50	45.000	4,50
20	Human skeleton	1	sheet	45.000	4,50	45.000	4,50
21	Invertebrate excretion system	1	sheet	45.000	4,50	45.000	4,50
22	Mendel law	1	sheet	45.000	4,50	45.000	4,50
23	metode penyerbukan	1	sheet	45.000	4,50	45.000	4,50
24	Molecular geometry	1	sheet	45.000	4,50	45.000	4,50
25	Molecule	1	sheet	45.000	4,50	45.000	4,50
26	Monocellular animal dev.	1	sheet	45.000	4,50	45.000	4,50
27	Multicellular animal dev.	1	sheet	45.000	4,50	45.000	4,50
28	Nitrogen gas production	1	sheet	45.000	4,50	45.000	4,50

Table Twelve: Biology and Chemistry Equipment and Materials

No.	Name	Qty	Per	Unit Cost	Total Cost	Unit Cost	Total Cost
				Rp.	US	Rp.	US
29	Oil refining	1	sheet	45.000	4,50	45.000	4,50
30	Periodic table	1	sheet	45.000	4,50	45.000	4,50
31	Plant anatomy	1	sheet	45.000	4,50	45.000	4,50
32	Primitive animal & environment	1	sheet	45.000	4,50	45.000	4,50
33	protozoa	1	sheet	45.000	4,50	45.000	4,50
34	Pteridophyta cycle	1	sheet	45.000	4,50	45.000	4,50
35	Skin	1	sheet	45.000	4,50	45.000	4,50
36	Vegetative plant dev.	1	sheet	45.000	4,50	45.000	4,50
37	Viruses	1	sheet	45.000	4,50	45.000	4,50
	TOTAL					***1.719.500***	171,95
	TOTAL DISPLAY					***7.925.400***	***792,54***

8. CHEMICALS & OTHER MATERIALS

(one year supply for 30 students)

No.	Name	Qty	Per	Total Cost			
				Rp.		US	
1	Acetic acid (analysis grade)	500	ml	Rp	88.500	$	9
2	Aceton	500	ml	Rp	7.500	$	1
3	Aluminium foil	25	pcs	Rp	24.000	$	2
4	Ammonia (analysis grade)	500	ml	Rp	42.500	$	4
5	Amylum	250	g	Rp	47.500	$	5
6	Barium chloride	100	g	Rp	37.500	$	4
7	Benedict	500	ml	Rp	29.500	$	3
8	Blue litmus	1	pack	Rp	27.500	$	3
9	Blue Methylen, dye	25	ml	Rp	65.700	$	7
10	Bromine water	50	ml	Rp	75.000	$	8
11	Bromtimol blue (BTB)	10	ml	Rp	84.600	$	8

Table Twelve: Biology and Chemistry Equipment and Materials

12	Buffer solution pH= 4 dan 7	500	ml	Rp	87.200	$	9
13	Calcium carbonate	1000	g	Rp	56.000	$	6
14	Calcium hydroxide	500	g	Rp	77.500	$	8
15	Candle for dissecting pan	8	pcs	Rp	68.000	$	7
16	Cobalt (II) chloride	100	g	Rp	197.000	$	20
17	Cupper plate	500	g	Rp	174.000	$	17
18	Cupper(II) sulphat pentahydrate	500	g	Rp	56.000	$	6
19	D-fructose	1000	g	Rp	694.100	$	69
20	Distilled water + container	20	L	Rp	55.000	$	6
21	Eosin, dye	25	g	Rp	101.300	$	10
22	Ethanol	2	L	Rp	25.000	$	3
23	Filter paper, roll	2	roll	Rp	5.000	$	1
24	Filter paper, Whatman, medium	1	pack	Rp	16.000	$	2
25	Filter paper, Whatman, slow, Φ 90 mm	1	pack	Rp	16.000	$	2
26	formaldehyde	500	ml	Rp	46.000	$	5
27	formaldehyde 36%	500	g	Rp	46.000	$	5
28	Gelatin	500	mg	Rp	138.000	$	14
29	Glucose	250	g	Rp	30.000	$	3
30	Hydrochloric acid (analysis grade)	1000	ml	Rp	59.000	$	6
31	Hydrogen peroxide	500	ml	Rp	83.500	$	8
32	Iodium crystal	100	g	Rp	135.000	$	14
33	Iron (II) chloride	500	g	Rp	68.500	$	7
34	Iron (II) sulphide	500	g	Rp	54.300	$	5
35	Iron plate, t 0,1 mm	500	pcs	Rp	43.500	$	4
36	Iron powder	500	g	Rp	41.800	$	4
37	Jelly powder	10	g	Rp	29.500	$	3
38	Lead plate	250	g	Rp	65.000	$	7
39	Lead(II) nitrate	100	g	Rp	38.500	$	4
40	Lugol solution	1000	ml	Rp	62.500	$	6
41	Magnesium ribbon	25	g	Rp	56.000	$	6

Table Twelve: Biology and Chemistry Equipment and Materials

42	Manganese (II) sulphate, powder	500	g	Rp	158.000	$	16
43	Manganese (IV) oxide, powder	500	g	Rp	166.000	$	17
44	Marble chips	100	g	Rp	5.000	$	1
45	Nickel plate, t 0.15mm	100	g	Rp	167.500	$	17
46	Nitric acid (analysis grade)	500	ml	Rp	87.500	$	9
47	Orange Methylen, dye	10	g	Rp	23.000	$	2
48	Phenolphthalein (PP)	25	ml	Rp	43.500	$	4
49	Potassium chromate	500	g	Rp	155.000	$	16
50	Potassium dichromate	500	g	Rp	120.000	$	12
51	Potassium hydroxide	500	g	Rp	74.000	$	7
52	Potassium iodide	500	g	Rp	484.000	$	48
53	Potassium permanganate	500	g	Rp	145.200	$	15
54	Red litmus	1	pack	Rp	27.500	$	3
55	Red Methylen, dye	10	g	Rp	52.500	$	5
56	Silver nitrate	100	g	Rp	537.500	$	54
57	Sodium chloride, pure	1000	g	Rp	67.500	$	7
58	Sodium hydroxide, leaflet	500	g	Rp	52.500	$	5
59	Spiritus	10	L	Rp	5.000	$	1
60	Sucrose	1000	g	Rp	172.000	$	17
61	Sulphuric acid (analysis grade)	1000	ml	Rp	75.000	$	8
62	Sulphur powder	500	g	Rp	42.700	$	4
63	Thin layer chromatography plate	1	pack	Rp	990.000	$	99
64	Tin plate	250	g	Rp	149.000	$	15
65	Universal Indicator , pH 1-14	2	pack	Rp	38.200	$	4
66	Vaseline	200	g	Rp	75.000	$	8
67	Zink chloride powder	100	g	Rp	50.000	$	5
68	Zink plate	250	g	Rp	65.000	$	7
TOTAL (CHEMICALS & OTHER MATERIALS)					***7183.10***		***718.31***

Table Twelve: Biology and Chemistry Equipment and Materials

TOTAL BIOLOGY & CHEMISTRY LAB	*Rp 936.585.705*	*93,659*

Table Thirteen: Materials and Equipment for Physics

No	Name		No Katalog/ Spek	Rational	Number of Unit	Unit CosT (Rp)	Unit CosT (US $)	Total CosT (Rp)	Total CosT (US $)
1	**AIR TRAC EXPERIMENT SET**		**A/S S.**	**Percobaan gerak**	1 Buah	Rp 7.950.000	$ 795	Rp 7.950.000	$ 795
	1 ea	Electronic Counter	**FREDERIKSEN**	gerak lurus beraturan					
	1 ea	Power Supply		gerak lurus berubah beraturan (GLBB)					
	1 ea	Switch Box							
	1 ea	Air Blower With Tube							
	2 ea	Electric auncher							
	1 ea	Air Track							
	1 ea	Standard Air							
		Track Accessory Set							
	2 ea	Photocell Unit							
	1 ea	Slotted Weights							
	1 ea	Aperture w/Notch							
	1 ea	Aperture For Mounting							
	1 ea	Endstop							
	1 ea	Protective Cover							
2	**FREE FALL EXPERIMENT SET**		**A/S S.**	**Untuk percobaan**	1 Buah	Rp 2.395.000	$ 240	Rp 2.395.000	$ 240

	1 ea Power Supply 1 ea Switch Box 1 ea Free Fall Apparatus 2 ea Mounting Brakets 1 ea Retort Stand Base 1 ea Retort Stand Rod Steel Ball (16 mm) Steel Ball (10 mm) Laboratory test leads with 4 mm jacks	**FREDERIKSEN**	**gerak jatuh**					
3	**STUDENT TRANSFORMER SET** 1 ea Cardboard Square fr Cil 1 ea U - Core with Armature 1 ea Power Supply 1 ea Armature Massive 1 ea Armature Laminated 1 ea Coil GREY (3200) 1 ea Coil RED (1600) 1 ea Coil BLUE (200)	**A/S S.** **FREDERIKSEN**	**Sumber tegangan** **untuk peralatan** dl. eksperimen	1 Buah	Rp 3.750.000	$ 375	Rp 3.750.000	$ 375

	1 ea	Coil YELLOW (400)							
	1 ea	Bar Magnet ALNICO							
	1 ea	Galvanometer Insert							
	1 ea	Voltmeter							
	1 ea	Ammeter							
	10 ea	Test Leads Cable							
5	**ELECTROMECHANICAL VIBRATOR EXPERIMENT SET**		**A/S S.**	**eksperimen**	1 Buah	Rp 57.536.000	$ 5.754	Rp 57.536.000	$ 5.754
	1 ea	Elec. Mechanical Vibrator Unit	**FREDERIKSEN**	**bentuk gelombang**					
	1 ea	Function Generator Unit		mekanik					
	1 ea	Pano Wire Ring							
	1 ea	Square Resonance Plate							
	1 ea	Circular Resonance Plate							
	1 ea	Flat String for Resonance Expt							
	1 ea	Rubber String							
6	**RESONANCE PIPE FOR SOUND EXPERIMENTS**		**A/S S.**	**eksperimen resonansi**	1 Buah	Rp 43.552.170	$ 4.355	Rp 43.552.170	$ 4.355

	1 ea Resonance piper	**FREDERIKSEN**	**gelb bunyi**					
	1 ea Microphone Probe							
	2 ea Retotort stand Base, Tripod							
	2 ea Holder With a 10 mm diameter rod for Support Resonance piper							
	1 ea Function generator							
	1 ea Power Supply							
	1 ea Digital Multimeter Mode 120							
	(Oscilloscope optional)							
	6 ea Test leads Cable							
9	**THERMAL EXPANSION APPARATUS (TD-8558A)**	**PASCO**	**untuk ekserimen**	1 Buah	Rp 2.000.000	$ 200	Rp 2.000.000	$ 200
	2 ea Built-in Dial Gauge		ekspansi termal					
	3 ea Drop-in Metal Tubes							
	1 ea Input Jacks for Digital Ohmmeter							
	1 ea Built-in Thermistor							
	1 ea Digital Multimeter							

13	**SONOMETER SYSTEM (WA-9757)**		**PASCO**	**eksperimen**	1 Buah	Rp 7.500.000	$ 750	Rp 7.500.000	$ 750
	1 ea	Investigate Waves on a Wire		gelombang					
	1 ea	Control Length, Tension, Density and Driving Frequency		mengamati bentuk dan mengukur frtekuensi					
	1 ea	Observe and Measure the Waveforms on an Oscilloscope							
	1 ea	Detector Coils includes (WA-9757)							
	1 ea	Detector Coils (Pair) (WA-9613)							
11	**RADIOACTIVITY RADIATION EXPERIMENT SET**		**A/S S. FREDERIKSEN**	**Untuk eksperimen aktivitas radioaktif**	1 Set	Rp 68.953.800	$ 6.895	Rp 68.953.800	$ 6.895
	1 ea	Measuring Arrangement							
	1 ea	GM Detector w/BNC Connect							
	1 ea	GM Detector Holder for Support Bench							
	1 ea	GM Counter Digital w/Memory							

	1 ea Source Holder on Rod Including Absorption Plates 1 ea Radioactive Source w/holder (storage Black)							
13	**SPECTROPHOTOMETER** Educational Spectrophotometer Accessory Kit OS - 8537 Educational Spectrophotometer System OS - 8539 - Analyze and Graph Spectral Lines - Explore Relationship Between Angle, Wavelength and Intensity - Versatile and Inexpensive 1 ea Collimating Slits Set of 5 slits ranging from 0,1 - 1,5 mm	**PASCO**	**Untuk percobaan :** difraksi spektrom pada kisi,	1 Set	Rp 71.856.000	$ 7.186	Rp 71.856.000	$ 7.186

	1 ea Collimating Lens (100mm focal Length, 50mm dia. Coated lens).							
	1 ea Diffraction Grating (High-quality, 600 Lines/mm grating Strongly Blazed in the first order)							
	1 ea Focusing Lens (100mm Focal Length, 50mm dia. Coated Lens)							
	1 ea Rotating Light Sensor Arm and Table (The arm can rotate 360 degrees)							
	1 ea CI-6604 High-Sensitivity Light Sensor Provides full-scale, switch selectable range of Approximately 5,0.5 and 0.05 lux (full aperture).							

		Spectral Response - 320-1100nm.							
	1 ea	Aperture Bracket with Light Sensor							
		Allows selection of aperture slits from 0,1 to 1,5 mm in 6 steps. The 0,1 mm slit, when used with a 600 lines/mm grating, permits resolution to 1.5 nm.							
	1 ea	Rotary motion sensor							
		Sensor is coiled to the rotating table via a friction rim drive. Resolves to 15 arc second.							
	-	Educational Spectrophotometer Components							
		The Spectrophotometer Accessory Kit includes:							

	1. Spectrophotometer Base (not shown) 2. Rotating Arm 3. Collimating Slits and Lens 4. Focusing Lens 5. Diffraction Grating and Holder 6. Rod Stand Mounting Brackets (not shown) The Spectrophotometer System includes: 1 - 6 above and 7 - 10 below. 7. Optics Benc (60 cm) 8. CI - 6538 Rotary Motion Sensor 9. CI - 6604 High-Sensitivity Light Sensor 10.OS - 8534 Aperture Bracket							

14	**PRISM SPECTROPHOTOMETER KIT (0S - 8544)** High - Quality Prism Light Sensor Seens Into Infrared Blackbody Light Source 1 ea — Blackbody Light Source (OS - 8542) Incandescent bulb provides a continuous spectrum, 6 V DC 1 ea — Prism Dense flint glass, 60 degrees (OS -8543) 1 ea — Broad Spectrum Light Sensor	**PASCO**	**eksperimen difraksi** cahaya impra red pada kisi	1 Set	Rp 29.228.400	$ 2.923	Rp 29.228.400	$ 2.923
15	**MICROWAVE OPTICS** Basic System WA - 9314 B Advanced System WA - 9316	**PASCO**	**untuk eksperimen** gelombang mikro	1 Set	Rp 50.000.000	$ 5.000	Rp 50.000.000	$ 5.000

	- Wave Optics in the Centimeter Range							
	- Rugged Gunn Diode Transmitter							
	- Receiver with a Built - in Amplifier							
	1 ea Diffraction Slit Hardware							
	1 ea Prism with Styrene Pellets							
	1 ea Rotating Mounts							
	1 ea Gunn Dioda Transmitter							
	1 ea Magnetic Mounting							
	1 ea 18 cm High Mounts							
	1 ea Durable Construction							
	1 ea Long - Arm Goniometer							
	1 ea Receiver with a Built - in Amplifier							
17	**Advanced Optics Systems Components**	**PASCO**	**Eksperimen optik**	1 Set	Rp 55.165.600	$ 5.517	Rp 55.165.600	$ 5.517
	Refraction Effects		mempelajari					

	1 ea	Glass Plate-Advanced Optics OS-9128		difraksi cahaya					
	1 ea	Acrylic Plate OS-9129		pada kaca, prisma					
	1 ea	Prism-Advanced Optics OS-9130		dan pada kisi					
	1 ea	Glass Dispersion Tank OS-9108							
	1 ea	Opaque Points & Fresnel. Zone-Advanced Optics OS-9126							
	1 ea	Diffraction Grating-Advanced Optics OS-9127							
	1 ea	Hologram-Advanced Optics OS-9115							
		Spectral (Color) Filters							
	1 ea	Spectral Filter (red)-Advanced Optics OS-9111							
	1 ea	Spectral Filter (yellow)-Advanced Optics OS-9112							
	1 ea	Spectral Filter (green)-Advanced Optics OS-9113							

	1 ea	Spectral Filter (blue) - Advanced optics OS-9114							
		Electroformed Diffraction Slits							
	1 ea	Minilaser w/Bracket OS-8514							
	1 ea	Complete Slit Set-Advance Optic OS-9165							
	1 ea	Single Double Slits-Advanced Optics OS-9176							
		Image Formation							
	1 ea	Diffuser-Advanced Optics OS-9120							
	1 ea	Crossed Arrow Target-Advanced Optics OS-9121							
	1 ea	Viewing Screen-Advanced Optics OS-9138							
	1 ea	Fitted Case (for Optical Components) OS-9140							
		Apertures							

	1 ea Photometer Apertures-Advanced Optics OS-9116							
	1 ea Aperture Mask-Advanced Optic OS-9139							
	1 ea Variable Diaphragm-Advanced Optics OS-9117							
	1 ea Light Source Aperture (0,5, 0,75)-Advanced Optics OS-9118							
	1 ea Light Source Aperture (1,0, 2,0)-Advanced Optics OS-9119							
19	**STUDENT SPECTROMETER (SP-9268 A)** - Wide Aperture Optics - Precision Vernier-Resolves 1 Minute of Arc - Durable and Precise 1 ea Student Spectrometer SP-9268A	**PASCO**	**eksperimen difraksi** beberapa jenis spektrum cahaya visible	1 Set	Rp 33.158.880	$ 3.316	Rp 33.158.880	$ 3.316

21	**COILS** - Field Coil (200 Turn) EM-6711 - Detector Coil (400 Turn) EM-6712 - Detector Coil (200 Turn) EM-6713 - LED Indicator ME-6714 - Leb top - Helmholtz Coil Base EM-6715 - Magnetic Field Sensor CI-6520A - Mounted on the end of the Linier Motion Accessory CI-6688 - As the Rotary Motion Sensor CI-6538	**PASCO**	**eksperimen** medan magnet, transformator	1 Set	Rp 3.750.000	$ 375	Rp 3.750.000	$ 375
23	**The e/m APPARATUS** - Sharp, Clearly Visible Electron Beam	**PASCO**	**eksperimen mempe-** lajari gerak elektron	1 Set	Rp 23.000.000	$ 2.300	Rp 23.000.000	$ 2.300

	- Lighted, Mirrored Scale Eliminates Parallax Errors		dalam medanmagnet					
	- Tube Rotates for General Study of Electrons in a Magnetic Field							
	1 ea Complete e/m System SE-9625							
	2 ea Multimeter Digital SE-9786A							
	1 ea e/m Apparatus SE-9638							
	1 ea Low Voltage Power Supply SF-9584							
	1 ea High Voltage Power Supply SF-9585							
	1 ea Red Patch Cords SE-9750							
	1 ea Black Patch Cords SE-9751							
24	**COULOMB'S LAW APPARATUS (ES-9070)**	**PASCO**	**percobaan**	1 Set	Rp 40.391.520	$ 4.039	Rp 40.391.520	$ 4.039
	- Accurately Measure Charge, Force and Distance		hukum Ohm					

	- Symmetric Design Minimizes Stray and Mirror Charges - Magnetic Damping for quick, Accurate Measurements 1 ea Kilovolt Power supply SF-9586 1 ea Basic Electrometer ES-9042 1 ea Faraday Ice Pail ES-9042A 1 ea Charge Producers ES-9057 B							
26	**LASER SPEED OF LIGHT SYSTEM (AP-8586)** - Easy Setup - Accurate Results - Low Cost 1 ea Wide Range Function Generator SB-8549A	**PASCO**	**eksperimen sinar** laser	1 Set	Rp 40.774.720	$ 4.077	Rp 40.774.720	$ 4.077

	1 ea	Tape Measure (30 m) SE-8712A							
	1 ea	Standard Photo Tripod 60 MHz Oscilloscope							
28	**MILIKAN APPARATUS** Economy Millikan Apparatus	A 6-6,3 VAC Power supply for the light source, a 200-500 VDC Power source for the millikan apparatus. See our TEL 2801 Also needed is a high impedance 0-500 VDC Voltmeter.	**TEL-ATOMIC**	**Eksperimen mengamati** partikel bermuatan	1 Set	Rp 27.545.000	$ 2.755	Rp 27.545.000	$ 2.755
29	**FRANCK-HERTZ EXPERIMENT IN MERCURY CP32047-00** The set contains a mercury Franck-Hertz tube : an oven with a built-in		**TEL-ATOMIC**	**untuk eksperimen** Franck-Hertz	1 Set	Rp 54.560.000	$ 5.456	Rp 54.560.000	$ 5.456

	temperature controller, a control unit, and a shielded cable with BNC connector. The oven and control box run on 110 VAC, 60 Hz line Voltage. Tube: - 3 electrodes, contains small amount of liquid mercury - Max. tube acceleration voltage 70 V Control Unit output: - Modes : Manual (for Voltmeter) or xy-recorder, ramp for oscilloscope or PC interface - Franck-Hertz signal :0-12 V - Accelerating Voltage : 0 - 7 V (1/10 of actual for voltmeter)								

	Controls: - Set potentiometer for heater voltage, acceleration, reverse bias and amplifier gain - Power 110 VAC/80 W. cord length 1,7 m - Size : 23,5 x 23 x17.5 cm Oven: - Thermo statistically controlled temperature - Tube permanently mounted in oven - Power : 110 V/450W , cord length 1,7 m - Size 17 x 19 x 33,5 cm								
30	**PLANCK'S CONSTAN EXPERIMENT PC 101**	Scientific	eksperimen menentukan	1	Set	Rp 36.609.520	$ 3.661	Rp 36.609.520	$ 3.661

	THE APARRATUS CONSIST OF THE FOLLOWING: 1. Photo Sensitive Device: Vacuum photo tube 2. Light Source: Halogen tungsten lamp 12V/35W. 3. Colour Filters: 635nm, 570nm, 540nm, 500nm & 460nm. 4. Accelerating Voltage: Regulated Voltage Power Supply, Output : 15 V continuously variable through multi-turn pot Display : 3 1/2 digit 7-segment LED Accuracy : 0.2 %		konstanta Planck					

	5. Current Detecting Unit : Digital Nanometer Range : 1000 mA, 100 mA, 10 mA, & 1mA with 100% over ranging facility Resolution: 1 Na at 1mA range Display : 3 1/2 digit 7-segment LED Accuracy : 0.2 % 6. Power Requirement: 220V 10 %, 50Hz 7. Optical Bench: The light source can be moved along it to adjust the distance between light source and phototube scale length is 400 mm.							

	A drawtube is provided to install colour filter, a focus lens is fixed in the back end.							
32	**ELEKTRONIKA** **BASIC ELECTRONICS LABORATORY SL-9727** - Comprehensive Introduction to Electronics - Add an Oscilloscope and a Multimeter for a Complete Lab Station - Solderless Breadboard Connections 1 ea ACT-1 Breadboard 1 ea AC Power Supply 1 ea Components Package SL-9728 1 ea Student Lab/Textbook SL-9729	**PASCO**	**Untuk mempelajari** dasar rangkaian elektronik	1 Set	Rp 31.831.200	$ 3.183	Rp 31.831.200	$ 3.183

	1 ea Crib Sheets and Teacher's Manual SL-9734 1 ea General Purpose, Digital Multimeter SE-9589 1 ea 20 MHz Dual Trace Oscilloscope SB-9591A 1 ea Digital LCR Meter SB-9754							
33	**BASIC ELEKTRICITY EM-8622** - Durable, Easy-to-use Kits - Explore Basic Electronics - Complete Lab Manual 2 ea 4 D Batteries Per Kit, Basic Digital Multimeters SE-9786A 2 ea Analog Multimeters SB-9623B 1 ea Light Bulbs (#14,25 Pack) EM-8627	**PASCO**	**eksperimen** mempelajari rangkaian seri-paralel	1 Set	Rp 15.000.000	$ 1.500	Rp 15.000.000	$ 1.500

	1 ea Electronic Components-Basic Elektricity Lab EM-8663 1 ea Series/Parallel Circuit EM-8677							
	1 ea Replacement Bulbs (5 Pack) EM-8697 1 ea Hand-Crank Generator EM-8090							
34	**Study of Multivibrators** The set-up consists of circuit of three type of multivibrators: 1. Fee Running Multivibrator 2. Bistable multivibrator 3. Univibrator and their stabilized power supply, all mounted on a decorated bakelite board. Usual provisions for convenient inputs		**Experimen mempelajari** rangkaian pembangkit getaran	1 Set	Rp 33.107.300	$ 3.311	Rp 33.107.300	$ 3.311

	and outputs are provided on binding terminals. The free running multivibrator also serve as a puise generator for the study of bistable multivibrator and univibrator The following studies can be done with this set-up - Study of a Bistable multivibrator - Study of a Fee Running multivibrator - Study of a Univibrator							
37	**STUDY OF POWER SUPPLY (SOLID STATE)** The set-up consists of a step-down transformer, a rectifier circuit (can		Experimen mempelajari rangkaian	1 Set	Rp 21.465.000	$ 2.147	Rp 21.465.000	$ 2.147

	be used as a half wave or a full-wave rectifier), a filter circuit (an inductance and two capacitors) The arrangement can be used for the study of various configurations of filters and a regulator circuit. The following studies can be carried out with set-up 1. Study of rectification : a. Full wave rectification b. Half wave rectification 2. Study of ac component : (Ripples) a. Efficiency of various type of filters L, ,T type etc. (Ripples) b. The effect of load		power suply					

	c. The effect of regulation 3. Regulation characteristics a. The effect of load on regulation b. The effect of change in main's voltage Brief Specifications Output : 0 - 12 Volts Max. Current : 200 mA Regulation : 1 % The experimental set-up is completer in all respect, except a multimeter and a CRO							
39	**STUDY OF BASIC OPERATIONAL AMPLIFIER, TYPE 741** The experimental set-up on the study of op.amp consists of a 741 IC	**Scientific**	**Experimen sistem** kerjaamplifier	1 Set	Rp 31.700.720	$ 3.170	Rp 31.700.720	$ 3.170

	with facilities for convenient connections, two regulated power supplies (12 V) , a variable voltage source and a multirange digital voltmeter with 3 1/2 digit LED display. The resistances (0,1 % metal film) required are mounted on the board separately, which may be connected as and when required through patch chords. The student can also connect external components, if required The following studies can be carried out - Working of the basic circuit.							

	- Measurement of bias and offset currents - Study of inverting and non-inverting amplifier configuration - Introduction to amplifier drft The set-up is complete in all respect.							
40	**STUDY OF APPLICATION OF OP.AMP TYPE 741** The set-up consists of 555 IC with facilities for convenient connection at the board, a power supply, built-in facilities for various type of triggers-variable frequency, variable voltage, and manual. The resistors	**scientific**	**Experimen** penguatan amplifier	1 Set	Rp 22.984.190	$ 2.298	Rp 22.984.190	$ 2.298

	acapacitors required are mounted on the board. The following studies can be carried out 1. Operation as a free running multivibrator 2. Operation as a monostable multivibrator 3. Operation as a preset time delay The above experimental set-up has been laid down on a decorated bacelite board with an aim of providing an easy understanding to the students. All components are well spread out for clarity and easy							

	repairs and replacement. The set-up is provided with a booklet, which contains its detailed theory of operation, description, specifications, suggestions and discussion on the various experiments that may be performed with it. The set-up is complete in all respect, including patch chords.							
41	**STUDY OF AN INTERGRATED CIRCUIT REGULATOR,** **TYPE - 723** The experimental set-up consists of an IC 723 with facilities for	Scientific	Eksperimen rangkaian regulator integral	1 Set	Rp 30.920.000	$ 3.092	Rp 30.920.000	$ 3.092

	convenient connections, an unregulated power supply, voltmeter, an ammeter and all the other components- resistance, potentiometer, variable load etc. required to perform the experiments. The following studies can be carried out 1. Working as a voltage regulator 2. Working as a current regulator The set-up is complete in all respect, including patch chords.							
TOTAL COST							**Rp 846.685.020**	**$ 84.669**

Section 3. Technology Costs

**Table One:
Technology Costs**

Details	Per	Quantity	Unit Cost (USD)	Total Cost (USD)
6 trolley each 20 laptop (P4, RAM 512, HD 80 GB, DVD CDRW Combo Drive, Blue Tooth, Infra Red, Wireless, Internal Modem)	unit	120	1.000	120.000
Subject specific software (1 set for each department)	unit	7	250	1.750
Administrator laptop (P4, RAM 512, HD 80 GB, DVD CDRW Combo Drive, Blue Tooth, Infra Red, Wireless, Internal Modem)	unit	1	1.000	1.000
LCD Projector	unit	7	130	910
Screen	unit	3	200	600
Printer	unit	6	250	1.500
PC	unit	22	800	17.600
Overhead Projector	unit	3	300	900
Camera (Canon EOS-350D + Lens)	pcs	1	900	900
VSAT for 1 provider	set	1	5.000	5.000
Internet connection (256 Kbps for unlimited quota)	month	2 year * 12 months/year = 24 months	750	1.500
Electronic encyclopedia subscriptions	unit	1	2.000	2.000
Digital Sources for library (books, journals, modules, etc)	set	1	1.000	1.000
Scanner	pcs	1	250	250
TV	set	3	250	750
Satellite TV access*	license		$333 installation+480($20 per month X 24 months)	813
Headsets	set	40	25	1.000
Total				**$ 157,473**

Section 4: Miscellaneous Costs

No	Details	Unit	Quantity	PRICE/ UNIT*	TOTAL*
				US $	US $
1	Shutters (single control panel)	meter	1	$ 22	$ 22
2	Partitions	meter	2.2 meters high. Price increases with height (450000)	300 or 450	N/A
3	Generator Genset (75 KVA, Silence)	pcs	1	$1,650	$1,650
4	Anzeca floor cover		30 x 30 m.	$120	$ 120
5	Carpet (Style: 2009 Stonebridge 40 oz. Soft Yarn Spun Nylon Textured Plush)	meter	10 m * 12 m = 120	$ 8	$ 960
6	Trash barrel (3 per floor in corridors)	pcs	18	$ 5	$ 90
7	Fire extinguisher, 3 kg (each floor, two units per floor)	pcs	6	$ 55	$ 331.92
8	First aid kit (One in science lab, 7 located in public spaces around building)	set	7	$ 50	$ 350
9	Skylight	set	1	$ 2,000	$ 2,000
10	Solar panel	unit	1	$ 350	$ 350
11	Iron grills (windows)	set	2	$ 100	$ 200
12	Grilled outer door (library)	set	2	$ 299	$ 598
13	Carts	unit	5	$ 25	$ 125
14	Acoustic reinforced/double wall windows	unit			N/A
15	Doors	unit			N/A
16	Cleaning supplies	set	5	$ 50	$ 250
Total					**$ 7,047 ***

*** Costing information was not available for all items.**

Section 5: All Costs